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Geol Survey

A GUIDE TO THE GEOLOGY OF THE CANTON AREA, FULTON COUNTY

Geological Science Field Trip

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ILLINOIS STATE GEOLOGICAL SURVEY
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GEOLOGICAL SCIENCE FIELD TRIPS are free tours conducted by the Educational Extension Unit of the Illinois State Geological Survey to acquaint the public with the geology, landscape, and mineral resources of Illinois. Each is an all-day excursion through one or several counties in Illinois; frequent stops are made for explorations, explanations, and collection of rocks and fossils. People of all ages and interests are welcome. The trips are especially helpful to teachers in preparing earth science units. Grade school students are welcome, but each must be accompanied by a parent. High school science classes should be supervised by at least one adult for each ten students. A list of previous field trip guide leaflets is available for planning class tours and private outings.

THE GEOLOGIC FRAMEWORK

Physiography and general geology of the area - The Canton field trip area in west-central Illinois encompasses a small portion of the Galesburg Plain, a part of the Till Plains Section of the Central Lowlands Province (fig. 1). The Galesburg Plain was created by Illinoian glaciers some 250,000 years ago. The Illinoian glacial deposits were later mantled with wind-blown Wisconsinan loess which in turn is being modified by post-Wisconsinan erosion and weathering. Most of the Galesburg Plain is in late youth in the erosion cycle. The region is characterized by fairly extensive reaches of flat to gently undulating uplands, some of which are relatively uneroded, and streams occupying narrow, V-shaped valleys that show little valley-flat or floodplain development.

Glacial deposits average 30 to 40 feet thick across the area, but exceed 100 feet in some buried bedrock valleys. Some glacial boulders found here weigh several tons. Loess thickness increases from about 9 feet in the northwestern part of the area to more than 15 feet in the southeast, near the Illinois River Valley.

Before Pleistocene glaciation commenced, the region now in the Till Plains Section had undergone a long and complex erosional history during which the central Illinois peneplain was eroded into the weak rocks of Pennsylvanian age east of the present Illinois River. This extensive lowland was bordered on the south and west by uplands which contained remnants of an older erosional surface. A system of deep valleys was eroded into the central Illinois lowland just prior to glaciation. Many of these pre-Pleistocene valleys are occupied in whole or in part by the present drainage systems. Gross features of the Till Plains Section, as well as some local features, have been determined largely by the preglacial topography. The greater relief and higher elevation in the Galesburg Plain result from the underlying preglacial uplands located there.

With the approach of pre-Illinoian glaciers, the major streams changed from eroding their valleys to aggrading and valley-filling because of increased sediment loads (clay, silt, sand, gravel, cobbles) supplied by the advancing glaciers and misaligned drainageways. Available evidence indicates that valley-fill materials were only partially removed by various pre-Illinoian interglacial stages.

Pre-Illinoian glacial deposits are sporadic in their occurrence across Illinois and their areal extent is not well known, mainly because the early deposits were severely eroded by subsequent glaciations. Younger glacial deposits conceal the pre-Illinoian material except in western Illinois where the older glacial debris is exposed in some valley walls beneath the outer edge of the sheet of Illinoian drift (see Glacial Map of Illinois in PLEISTOCENE GLACIATIONS IN ILLINOIS in appendix). Wanless (1957) reported pre-Illinoian glacial deposits along the lower part of the Copperas Creek, just to the east of the field trip area, and along Big Sister Creek at the southwestern edge of the field trip area.

The western part of the field trip area, roughly west of a north-south line about a mile west of State Route (SR) 78 between Canton and Norris, is underlain by the Hulick Till Member of the Glasford Formation deposited during the middle Illinoian Monican Substage (see Time Table of Pleistocene Glaciation in

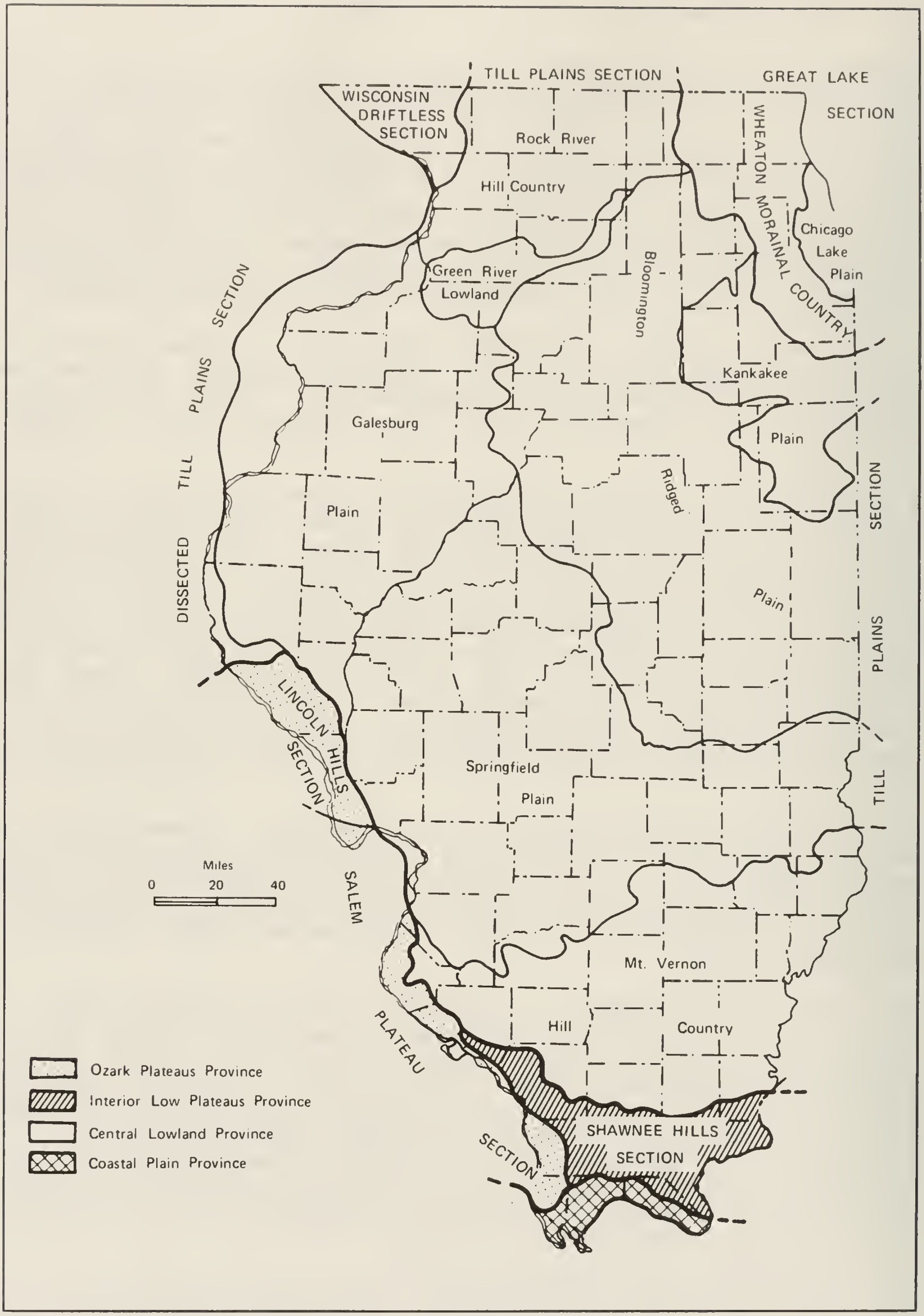


Figure 1 Physiographic divisions of Illinois

PLEISTOCENE GLACIATIONS IN ILLINOIS in appendix). The area to the east of the north-south line is underlain by the Radnor Till Member of the Glasford Formation deposited during the late Illinoian Jubileean Substage.

The highest surface elevation in the Canton field trip area is slightly more than 780 feet above mean sea level (m.s.l.) at Stop #2. The lowest elevation is less than 440 feet above m.s.l. along the Illinois River bank near Stop #7. The maximum surface relief in the field trip area, therefore, is greater than 340 feet. The largest local relief is along U.S. Route 24 (US-24) about 3.25 miles east-northeast from Stop #6, where the upland rises more than 150 feet above the upper part of the valley plain within 0.1 mile.

This field trip area sits astride the preglacial divide separating drainage to the east and southeast via Kickapoo Creek to the Ancient Mississippi River and between drainage to the west and southwwest via the Lower Spoon River to the Ancient Mississippi River. The modern drainage divide is essentially the same in the field trip area with Copperas Creek and other smaller streams draining the east and southeast portions to the Illinois River. Spoon River carries modern drainage from the west and southwest to the Illinois River via several of its larger tributaries. The Illinois River forms the southeastern boundary of Fulton County for approximately 31 miles.

A. H. Worthen, the second director of the Geological Survey of Illinois, in 1870, reported that Fulton County was about equally divided into prairie and woodlands. The prairie occupied the uplands and part of the Illinois River floodplain. He noted that the uplands generally have a slightly rolling surface except near Fairview, about 4.5 miles west of Stop #2, where the prairie is so flat that it needed to be drained during wet seasons.

The bedrock strata that immediately underlie the surficial materials in the Canton area are Pennsylvanian in age. The were formed from sediments that were deposited some 290 million years ago when what is now Illinois was covered by shallow seas and large swamps near the seashore (see attached DEPOSITIONAL HISTORY OF THE PENNSYLVANIAN ROCKS). These sediments were deposited across an uneven erosional surface developed in underlying Mississippian strata. A maximum thickness of Pennsylvanian strata of 325 feet was reported in a deep water well at Canton.

According to Director A. H. Worthen (1870),

> "...Nearly all the uplands in the county (Fulton) are underlaid by coal, and we have found here the most complete exposure of the productive Coal Measures (Pennsylvanian strata) that have been met with in the State, and hence the section constructed in this county will be considered a typical one, and will be used for the co-ordination of the coal strata throughout the central and western portions of the State. We have found here seven consecutive seams, all exposed by their natural outcrop, within the county, and all, except the upper one, have been worked to a greater or less extent. The aggregate thickness of these seams is about twenty-five feet, and their individual range is from twenty inches to six feet in thickness...These coals have been numbered from the bottom upward..."

Pennsylvanian strata encountered on the Canton field trip range from the Springfield Coal Member underclay of the Carbondale Formation to the overlying

Farmington Shale Member of the Modesto Formation. The aggregate thickness of these strata is approximately 120 feet.

Following is a composite section based on the J. S. Young/Midland Electric Coal Company well, one of the deepest wells in the field trip area, and the log of the Alden Coal Company shaft. The well is located in the NE 1/4 SE 1/4 NE 1/4 Sec. 2, T. 8 N., R. 3 E., 4th P.M. and the shaft is located on the west side of the SW 1/4 NW 1/4 SW 1/4 Sec. 27, T. 8 N., R. 4 E., 4th P.M.

CENOZOIC ERA		
Quaternary System		
Pleistocene Series	35 feet	Loess, glacial till
PALEOZOIC ERA		
Pennsylvanian System		
Desmoinesian Series		
McLeansboro Group		
Modesto Formation	47 feet	Shale
Kewanee Group		
Carbondale Formation	269 feet	Coal, shale, limestone
Spoon Formation	53 feet	Shale, limestone
Mississippian System		
Valmeyeran Series		
Keokuk/Burlington Limestone	153 feet	Dolomite, limestone
Kinderhookian Series		
Hannibal Shale	12 feet	Shale
Devonian System		
Upper		
Grassy Creek Shale	242 feet	Shale
Middle		
Cedar Valley/Wapsipinicon Lss.	60 feet	Dolomite, limestone
Silurian System		
Niagaran/Alexandrian Series	118 feet	Dolomite, shale
Ordovician System		
Cincinnatian Series		
Maquoketa Group	184 feet	Shale, dolomite
Champlainian Series		
Galena/Platteville Groups	293 feet	Dolomite
Ancell Group		
Glenwood/St. Peter Formations	268 feet	Sandstone
Canadian Series		
Prairie du Chien Group		
Shakopee Dolomite	160 feet	Limestone, dolomite, shale, sandstone, chert
New Richmond Sandstone	72 feet	Sandstone, dolomite
Oneota Formation	353 feet	Limestone, dolomite
Gunter Formation	36 feet	Dolomite
Cambrian System		
Croixan Series		
Trempealeauan Stage	261 feet	Dolomite
Franconian Stage	131 feet	Dolomite
Dresbachian Stage		
Galesville Sandstone	137 feet	Sandstone
Eau Clair Formation	2 feet+	Dolomite
Total Depth	2886 feet	

Although these records show that the Eau Claire Formation was barely penetrated here, records from elsewhere in Illinois show that the formation ranges from 300 to 1,000 feet thick, and indications are that it may be approximately 350 feet thick in the Canton area. The underlying Cambrian Mt. Simon Sandstone ranges from 500 to 2600 feet thick, but indications are that it is probably about 1200 feet thick here. These two figures (350 ft. and 1200 ft.), when added to the section total given above, provide a total depth of about 4400 feet to the top of the Precambrian basement, which agrees fairly closely with Atherton's (1971) map of the structure on top of the Precambrian basement. Drill hole samples from other localities show that the Precambrian basement under Illinois is composed of crystalline granitic and gneissic igneous and metamorphic rocks.

The Canton area is located on the northwestern shelf of the Illinois Basin, a large spoon-shaped structural depression encompassing much of Illinois, as well as adjacent parts of southwestern Indiana and western Kentucky (fig. 2). The deepest part of this downwarp is located in southeastern Illinois and contains nearly three miles of Paleozoic rocks (fig. 3). Current thought, based on coalification studies, is that perhaps another mile of Paleozoic strata have been eroded away from the Illinois Basin.

Bedrock strata in Fulton County are tilted down slightly toward the east on an incline averaging less than 10 feet per mile, which is considerably less than a one-degree dip. The rocks are not everywhere tilted uniformly. According to Wanless (1957), the regional dip here has been changed somewhat by a series of seven roughly parallel, gently curved anticlines (upwarps) and synclines (downwarps) whose axes vary in trend from northeastward to eastward (fig. 4). These structures, which may link up with structures somewhat farther to the west and southwest, generally have a relief of less than 100 feet and are 20 to 25 miles long. The axes of these structures all plunge, or tilt downward, to the east. In addition, minor folds found in some of the mines may be the result of differential compaction of the original sediments. Some ice-shove folds are present in Pennsylvanian shales that were close to the ground surface during the Illinoian and/or Pre-Illinoian glaciations.

Mineral Production

Ninety-eight of the 102 counties in Illinois reported mineral production during 1985, the last year for which totals were available. The total value of all minerals extracted, processed, and manufactured in Illinois was more than $3.7 billion. In 1985, minerals extracted, in order of value, in Fulton County were coal, and sand and gravel, with a total value of more than $17.9 million. The county ranked 38th among Illinois mineral producing counties.

One surface mine operating in Springfield (No. 5) Coal in Fulton County produced more than 583 thousand tons of coal valued at more than $17.9 million in 1985. For that year, total tonnage of coal produced in 21 Illinois counties was more than 60.47 million tons valued at more than $1.86 billion. More than 236.8 million tons of coal have been strip mined in the county between 1833 and 1985. Total cumulative coal production for this period amounted to more than 313.4 million tons.

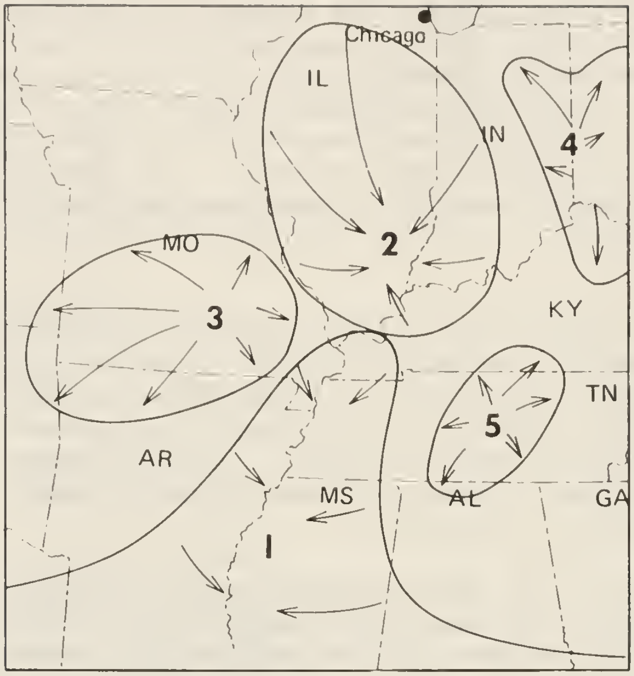


Figure 2 The location of the Mississippi Embayment and adjacent major structures: (1) Mississippi Embayment, (2) Illinois Basin, (3) Ozark Dome, (4) Cincinnati Arch, and (5) Nashville Dome.

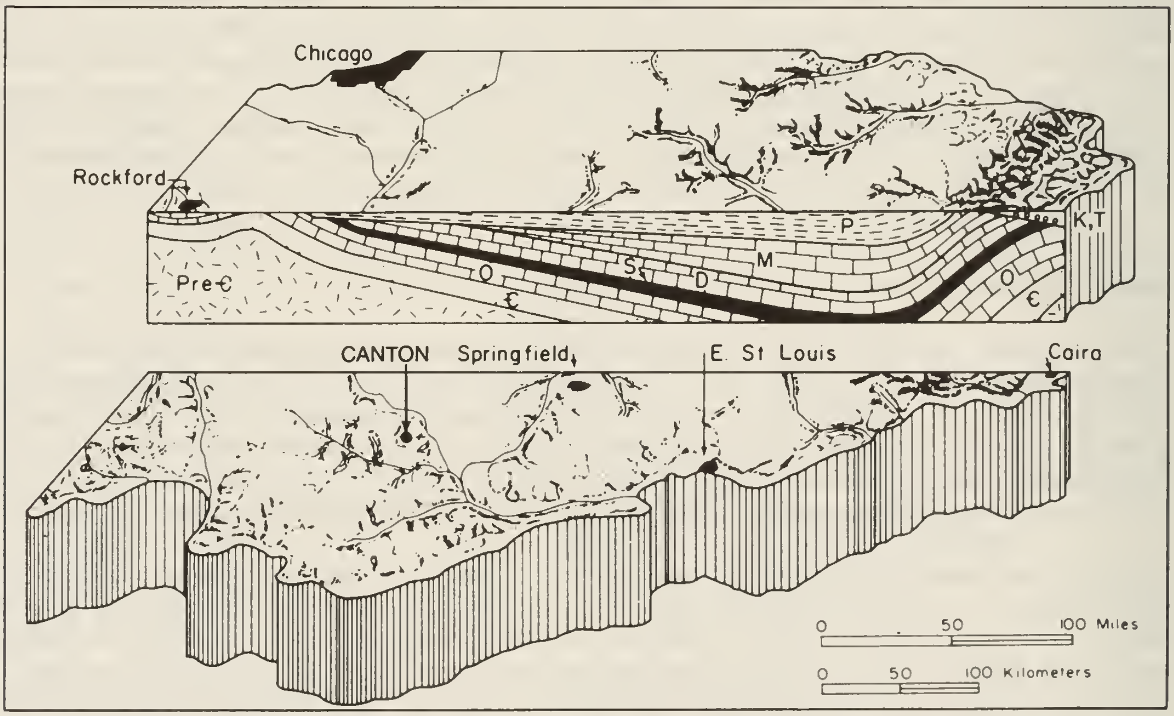


Figure 3 Stylized north-south cross section shows the structure of the Illinois Basin. In order to show detail, the thickness of the sedimentary rocks has been greatly exaggerated and the younger, unconsolidated surface deposits have been eliminated. The oldest rocks are Pre-cambrian (Pre-C) granites. They form a depression that is filled with layers of sedimentary rocks of various ages: Cambrian (C), Ordovician (O), Silurian (S), Devonian (D), Mississippian (M), Pennsylvanian (P), Cretaceous (K), and Tertiary (T). The scale is approximate.

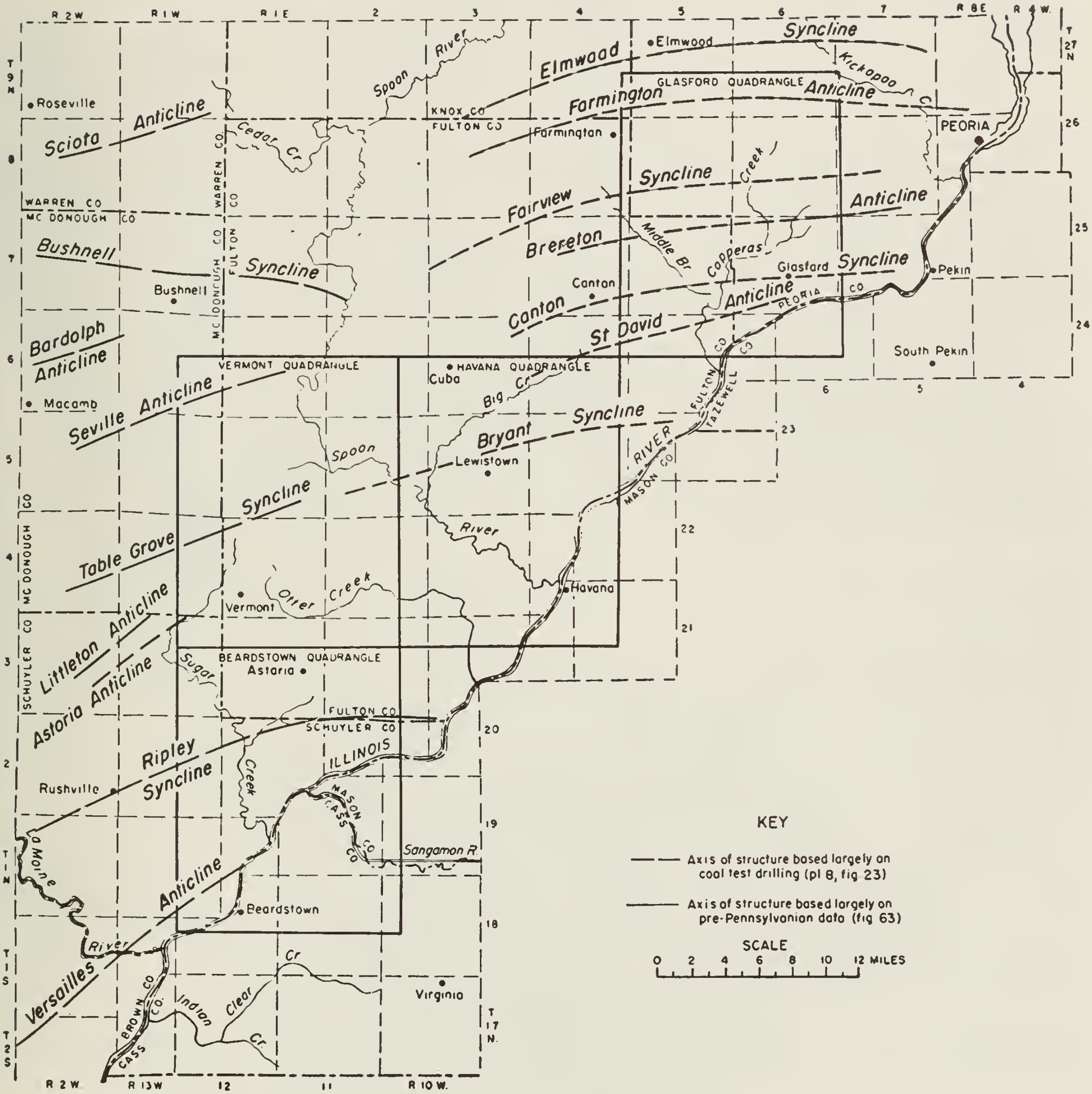
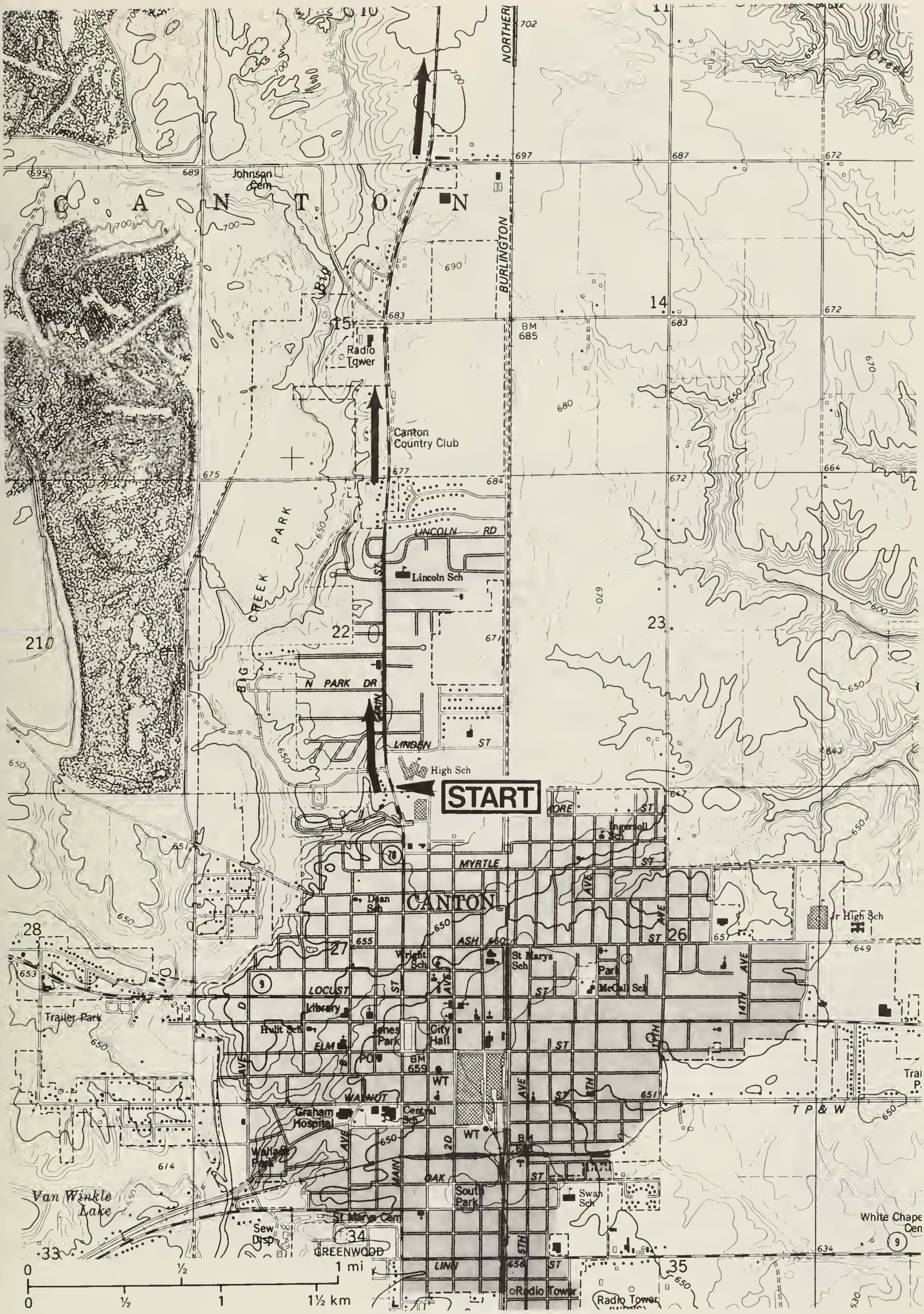


Figure 4 Axes of named structures.

Sand and gravel production was reported in Fulton County during 1985. Because the U.S. Bureau of Mines only surveys sand and gravel operators in even-numbered years, only estimates for the industry as a whole can be presented here. Nearly 26.6 million tons of sand and gravel having a value of more than $77 million were produced in Illinois that year.

Groundwater is a mineral resource that is frequently overlooked in assessments of an area's mineral potential. Groundwater occurs in aquifers--beds of glacial sand and gravel, stream alluvium, or porous or creviced bedrock strata. Those cracks and pore spaces are interconnected well enough to allow significant quantities of water to flow into a well or spring.

Shallow wells away from the permanent streams are the main source of water for farm use in the area. Although most of these wells obtain groundwater from the glacial materials, a number of wells have been deepened into the underlying bedrock, in some cases, to provide storage capacity at the well site. Shallow wells that are open to the sand and gravel at the base of the Illinoian till, 15 to 40 feet deep, have the highest yields. Some wells drilled into Pennsylvanian bedrock have provided water supplies with nearly the same yields as from the sands and gravels at the base of the Illinoian till. Canton and Cuba, in years past, got their water from deep wells drilled into the Ordovician St. Peter Sandstone at depths greater than 1,400 feet. The water was mineralized, but less so than water from other St. Peter wells about 25 miles farther south. In the late 1930s, Canton constructed a dam across the West Branch of Copperas Creek to impound a lake for its water supply. In recent years, some of the smaller neighboring communities have purchased water and laid mains from Canton to their communities.

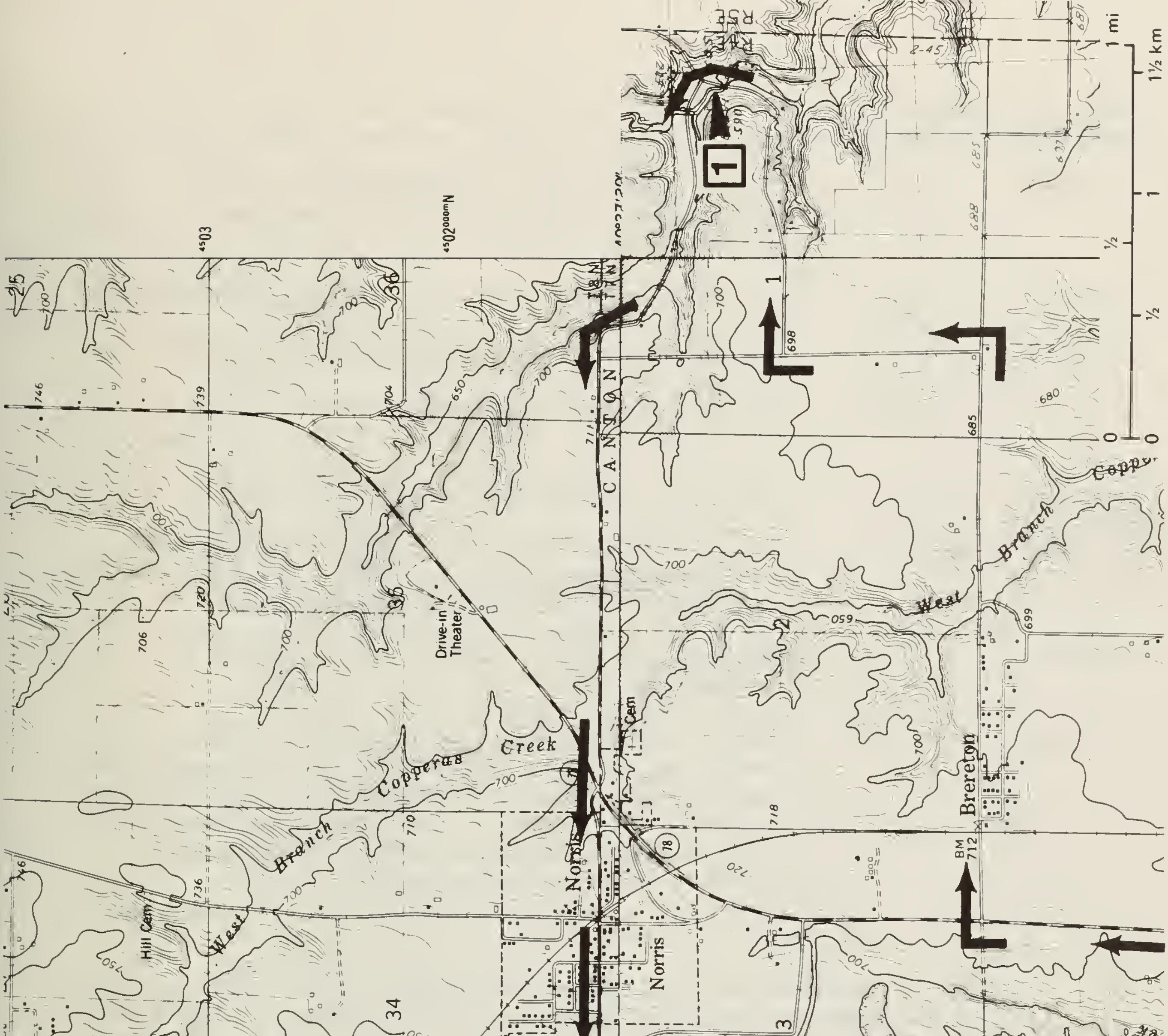

START
CANTON
Johnson Cem
Radio Tower
Canton Country Club
BIG CREEK PARK
LINCOLN RD
Lincoln Sch
N PARK DR
LINDEN ST
High Sch
MYRTLE
Ingersoll Sch
Dean Sch
Jr High Sch
ASH
St Marys Sch
Wright Sch
LOCUST
Park
McCall Sch
Library
Hulit Sch
Jones Park
City Hall
ELM
PO
BM 659
WT
WALNUT
Graham Hospital
Central Sch
T P & W
Wallace Park
OAK
South Park
Swan Sch
Van Winkle Lake
St Marys Cem
Sew Disp
GREENWOOD
LINN
Radio Tower
White Chapel Cem
BURLINGTON NORTHERN
Trailer Park
0 ½ 1 mi
0 ½ 1 1½ km

GUIDE TO THE ROUTE

NOTE: The number in parentheses following the topographic map name, (40090E1), is the code assigned to that map as part of the National Mapping Program. The state is divided into 1^{0} blocks of latitude and longitude. The first pair of numbers refers to the latitude of the southeast corner of the block and the next three numbers designates the longitude. The blocks are divided into 64 7.5-minute quadrangles; the letter refers to the east-west row from the bottom and the last digit refers to the north-south row from the right.

Assemble in the parking lot on the south side of Canton Community High School at 1001 North Main Street (east side of State Route 78). Mileage figures begin at the Main Street entrance to the School's circle driveway.

Miles to Next Point	Miles from Start	
0.0	0.0	TURN RIGHT (north) on State Route (SR) 78.
0.7+	0.7+	CAUTION: Stoplight--Lincoln Road. CONTINUE AHEAD (north).
1.45-	2.15	The upland in this area is relatively level as you note from side to side. To the west, the area has been strip-mined and reclaimed.
0.7	2.85	Prepare to turn right.
0.15+	3.0+	TURN RIGHT (east) on the Brereton Road (2900N 2170E)
0.05+	3.05+	The green structure, to the left about a quarter-mile, is an asphalt plant. It is on the site of the abandoned shaft of the Pschirrer Coal Company, which mined the Springfield (No. 5) Coal Member from the fall of 1936 until 1959, making it the oldest shaft mine in Fulton County. The Springfield Coal was 152 feet deep at the shaft and averaged 50 inches thick. The total amount of Springfield Coal recovered was 1,854,350 tons. A new mine opened in 1960 in the Herrin (No. 6) Coal Member using the same shaft to a depth of 80 feet. The Herrin Coal averaged 51 inches thick. The new mine produced 21,016 tons of Herrin Coal during its 18-month life. Because roof conditions were not good in the mine, it became increasingly difficult to mine the coal. Competition from the several large surface mines operating in the area, plus the mining conditions, and other economic conditions led to the demise of this coal company.
0.15	3.2+	CAUTION: One track [Burlington Northern (BN)] railroad, unguarded. Enter the hamlet of Brereton just beyond the track. CONTINUE AHEAD (east).



1
Norris
Norris
Brereton
West Branch Copperas Creek
West Branch Copperas
Big Creek
Industrial Waste Pond
Drive-in Theater
Hill Cem
Cem
CANTON
PRIVATE
PRIVATE
WT
BM 712
78
33
34
35
36
2
3
4
1 mi
1½ km

Miles to Next Point	Miles from Start	
0.55+	3.8	T-road intersection. CONTINUE AHEAD (east). Cross bridge over the West Branch Copperas Creek and begin gravel road.
0.6+	4.4+	T-road from left. TURN LEFT (north) (2900N 2300E).
0.5	4.9+	T-road from right. TURN RIGHT (east) (2950N 2300E).
0.2+	5.15	We are now starting to come down off of the upland into the valley of the Middle Branch Copperas Creek.
0.35	5.5	CAUTION: Descend hill; sharp curves ahead.
0.05+	5.55+	If you look to the right on the far valley wall above the housetrailer, you will see a couple of old abandoned mine openings in the hillside.
0.1+	5.7+	Cross Middle Branch Copperas Creek bridge and prepare to stop.
0.05-	5.75	Park along roadside. Do NOT park on bridge nor block the roadway. The discussion begins along the road northeast up the hill from the Y-intersection, proceeds down the hill, and then moves about 400 feet southeast along the north side of Copperas Creek to the high rock bluff.

STOP 1. Examination of the type locality of the Brereton Cyclothem and the type outcrop of the Brereton Limestone Member [SE 1/4 NE 1/4 NE 1/4 and E 1/2 SE 1/4 NE 1/4 Sec. 1, T. 7 N., R. 4 E., 4th P.M.; Banner 7.5-minute Quadrangle (40089E8)].

The surrounding area is the type locality of the Brereton Cyclothem and it contains the type outcrop of the Brereton Limestone Member of the Carbondale Formation. In other words, this area is where these particular rock units are typically developed, exposed, and displayed and from which they derive their names. There are several accessible places nearby where these stratigraphic units may be observed and studied. This particular location, however, has been designated as the type section--it is the original described sequence of units for this given locality and serves as the standard with which spatially separated exposures of the stratigraphic unit may be compared. Preferably a type section is chosen in an area where the unit shows its maximum thickness and is completely exposed. At the least, its top and bottom contacts should be exposed so that the unit's relationship to other strata can be established without doubt. Once a type section, outcrop, etc., has been established in the scientific literature, it cannot be changed, but new reference sections may be established if errors are discovered later, or if the original type section is destroyed by construction, submerged in a lake, or eroded away.

The Brereton limestone was named by Savage (1927). The Brereton cyclical formation was named by Wanless (1931). The following section is updated from Wanless (1957).

Pennsylvanian System	
Desmoinesian Series	
McLeansboro Group	
Modesto Formation	
Sparland Cyclothem	
Farmington Shale Member, gray, soft, weathers buff	4' 6"
Shale, black, soft to hard	3"
Kewanee Group	
Carbondale Formation	
Danville (No. 7) Coal Member	1' 7"
Underclay, light to dark gray, plastic	1'
Underclay, light gray	8'
Underclay, slightly sandy, calcareous; limestone concretions	1'
Copperas Creek Sandstone Member	
Sandstone, argillaceous, gray, weathers reddish-brown, massive	1'
Sandstone, buff to gray, fine-grained; shaly in upper part and massive below	12'
Brereton Cyclothem	
Lawson Shale Member, gray soft; small ironstone concretions	7' 4"
Shale, calcareous, yellow-gray, fossiliferous; crinoid stems and brachiopods	1' 4"
Brereton Limestone Member, gray; in two benches, the upper bench 2 feet 2 inches thick and more massive than the lower	3' 6"
Shale, light gray, weathers buff, soft; small black calcareous and pyritic concretions	4"
Anna Shale Member, black to dark gray	1"
Herrin (No. 6) Coal Member	
Coal, irregular masses of micaceous siltstone at top (white top)	8"
Coal	11 1/2"
Shale, medium gray, laminated	1/8-3/8"
Coal	11 1/4"
Clay, medium blue-gray (blue-band)	2 3/4"
Coal	3 1/2"
Pyrite	0-3/4"
Coal	5 3/4"
Clay, dark gray	3/4"
Coal	1' 1/2"
Underclay, noncalcareous, dark blue-gray	1'
Underclay, light gray	6"
Underclay, calcareous, light gray; contains selenite crystals	2' 6"
Vermilionville Sandstone Member, greenish-gray mottled brownish, hard; lower part calcareous	3'

St. David Cyclothem

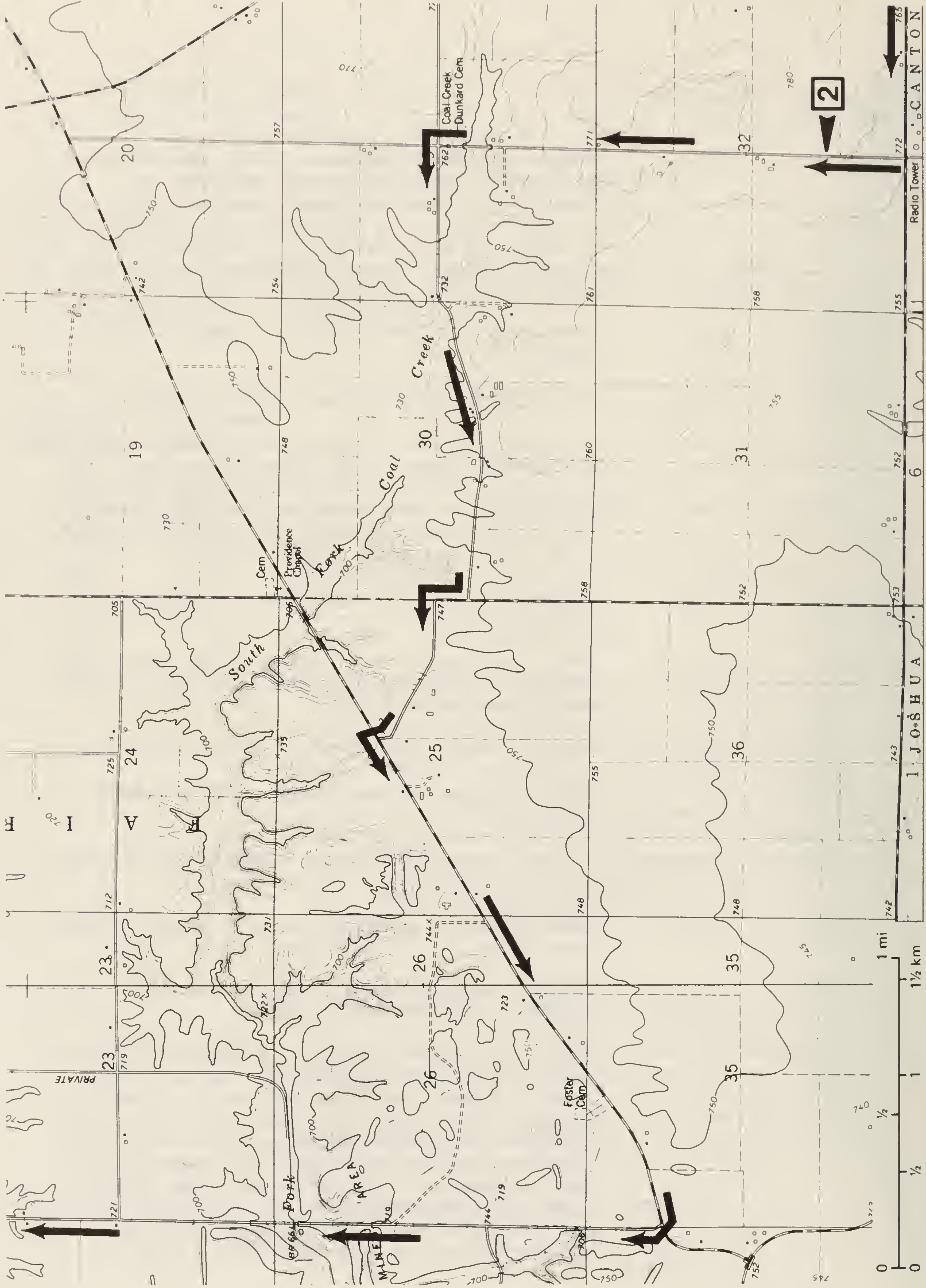
Canton Shale Member

Shale, slightly sandy, medium gray	4'
Shale, light greenish-gray; contains small ironstone concretions and limestone joint-fillings; base concealed	8'

Shortly after we leave this stop, the route will pass by several good exposures along Middle Branch Copperas Creek to the west. Do any of the exposed units in these outcrops look familiar?

Miles to Next Point	Miles from Start	
0.0	5.75	Leave Stop 1 and CONTINUE AHEAD preparing to turn left.
0.05-	5.8-	Y-intersection at base of the hill. BEAR LEFT (westerly).
0.05+	5.85+	CAUTION: Cross narrow bridge.
0.05+	5.95	To the left is an exposure on the south side of the Middle Branch Copperas Creek. This section shows, just below the grass and rootline at the top, the Herrin Coal underlain by its underclay and the Vermilionville Sandstone and about 5 ft of Canton Shale to creek level. Depending on the vegetative cover, as you CONTINUE AHEAD (westerly), you can look up the slope toward the left and see exposures or slump blocks of Brereton Limestone. You will also see some dumps or gob piles from old mines that were just driven into the Herrin Coal in the hillside. These are called "drift" or "dog-hole" mines.
0.15	6.1	To the left is another good exposure of the section, but there has been some slumping on part of it. Yet, there is a fair amount of section exposed with the Canton Shale at the bottom and the Brereton Limestone at the top. The section is about 35 ft. thick here. Just to the west of the exposure, back in the trees, is a gob pile. The trees have grown up through the material quite a bit, but you can see some of the black shale pile.
0.05+	6.15+	Cross Middle Branch Copperas Creek.

Miles to Next Point	Miles from Start	
0.1+	6.3-	To the left, 15-20 years ago before the undergrowth got so big on the hillside you could see the location of a number of dog-hole mines. There would be a small shale pile at the mine adit (entrance) and after the mine roof caved-in you would see a sag on the hillslope above. CONTINUE AHEAD (westerly) up the hill.
0.3+	6.6+	T-road from left (3000N 2320E). CONTINUE AHEAD (west).
0.8	7.4+	To the right, shale exposed in the road cut.
0.1+	7.5+	To the left across the West Branch Copperas Creek is the abandoned Rawalt Coal Company mine site. You see a lot of the debris from that mining operation on the site. The mine operated from 1924 through 1945 in the Springfield Coal. The coal averaged 48 inches thick at a depth of 116 feet.
0.05	7.55+	CAUTION: Cross West Branch Copperas Creek bridge. CONTINUE AHEAD.
0.1+	7.7	STOP: 2-way; crossroad. Intersection with SR 78. CROSS the highway and then BEAR LEFT (west) on the Norris Road (3000N 2210E).
0.05	7.75	CAUTION: Ascend hill into the village of Norris.
0.25+	8.0+	CAUTION: 1 guarded track BNRR. CONTINUE AHEAD (westerly).
0.05-	8.05	CAUTION: North Main Street. CONTINUE AHEAD (west) on Division Street.
0.2+	8.25+	Cross headwaters of Big Creek, a tributary to Spoon River.
0.35+	8.65	CAUTION: rough abandoned single track BNRR crossing. CONTINUE AHEAD (west).
0.35+	9.0+	To the left is the former garage and mine office of the Norris Mine of Consolidation Coal Co. The tipple site was just to the west of it a short distance. The large earth embankment to the right surrounds and contains the slurry pond where wash water from processing the coal was pumped so that the fine material could settle out. The cleared water was recirculated back into the tipple to wash more coal. The Norris Mine began mining the Springfield Coal in September, 1969. Later the


Coal Creek Dunkard Cem
Radio Tower
CANTON
JOSHUA
Providence Chapel
Cem
Foster Cem
South Fork Coal Creek
PRIVATE
MINE AREA
2
1 mi
1½ km

Miles to Next Point	Miles from Start	
		Herrin Coal also was mined, sometimes from the same pit as the Springfield. The Springfield averaged about 52 inches thick and the Herrin averaged about 40 inches thick Non-lithified overburden (glacial materials above the Pennsylvanian rocks) at this mine was dug from the highwall face by a large bucket-wheel excavator. A large shovel with a bucket capacity of 80-cubic yards dug the rock overburden from the top of the coal. This rock debris was dumped behind the shovel in a long continuous pile or ridge parallel to the highwall in the area from which the coal already had been removed. A long conveyor belt on the wheel excavator carried the loose glacial material to the end of its boom, where the material was dumped on top of the second debris ridge away from the highwall. The use of these two huge excavating machines not only enabled the company to surface mine to greater depths (100 to 150 feet), but also facilitated leveling the spoil ridges and reclaiming the land in the pre-reclamation law days. Norris Mine closed in September 1980 after having mined more than 10.4 million tons of the Springfield and Herrin Coals combined.
0.7+	9.75	Crossroad. CONTINUE AHEAD (west).
0.5	10.25+	Crossroad, TURN RIGHT (north) (3000N 1950E).
0.25	10.5+	Park along east side of road.

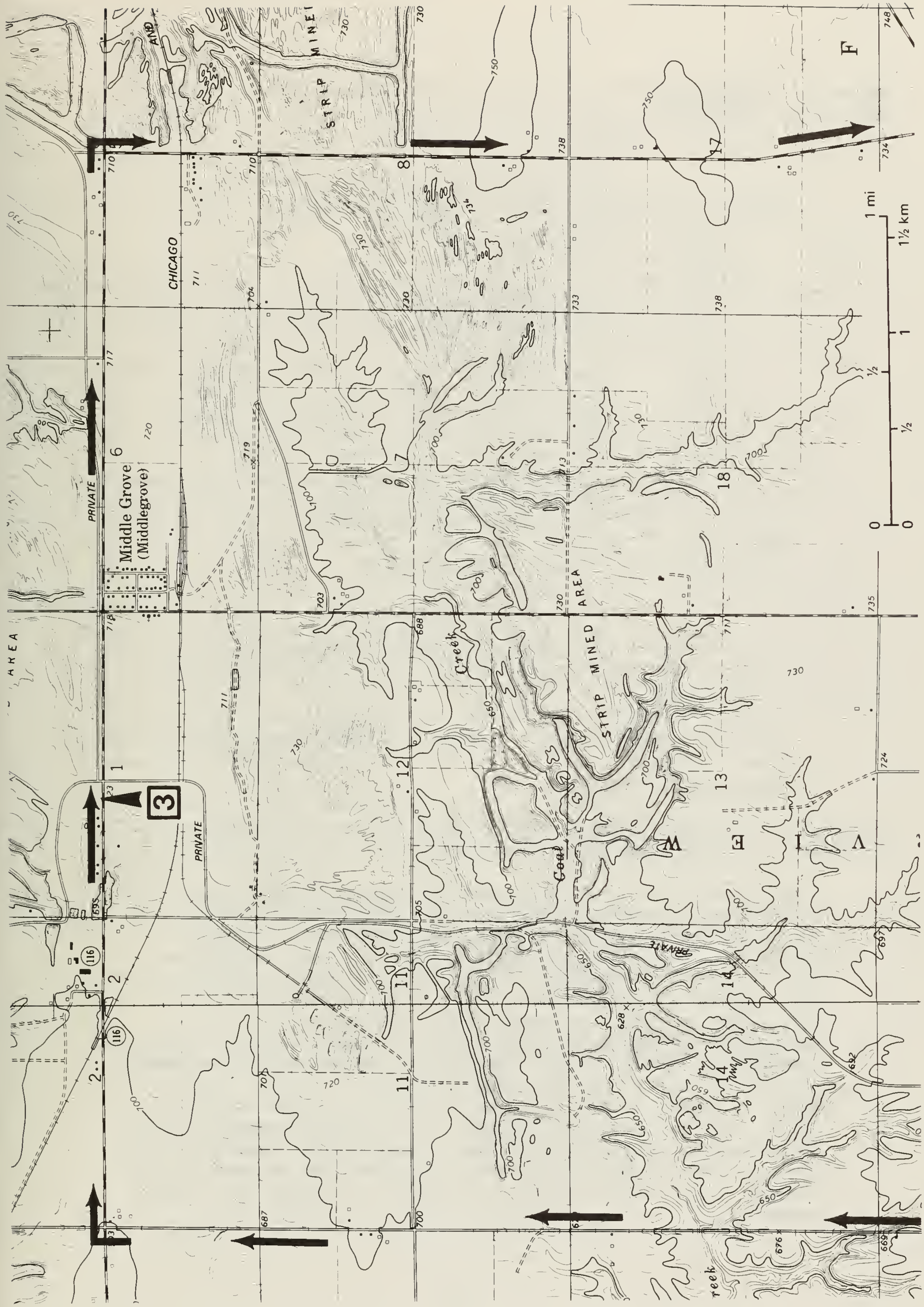
STOP 2. Discussion of uplands from the high point of the Illinoian Till Plain [NW 1/4 NW 1/4 SW 1/4 SW 1/4 Sec. 32, T. 7 N., R. 4 E., 4th P.M.; Farmington West 7.5-minute quadrangle (40090F1)].

The general slope of the Galesburg Plain (see fig. 1) is to the south in this area. The surface appears flat to gently undulating and the highest elevation on the field trip, slightly more than 780 feet m.s.l., is just to the east of the field.

As noted by Worthen (1870), the prairie here has been cleared in exchange for agricultural fields with the only remaining woods being limited mostly to the larger water courses. Some farmers have established grass waterways through their fields to minimize erosion of cultivated areas. Other farmers have installed concrete or block weirs, or dams, to minimize downcutting of cultivated fields and pastures.

Although we are located just south of the axial trough of the slightly asymmetrical Fairview Syncline (fig. 4, p. 7), there does not appear to be any surface expression of this buried structure. Wanless (1957) noted that drilling records indicate that the north side of this syncline, or downwarp, shows about 70 feet of relief while the southern limb shows about 50 feet of relief. The bedrock surface is 30 to 40 feet deep here.

Miles to Next Point	Miles from Start	
0.0	10.5+	Leave Stop 2. CONTINUE AHEAD (north).
1.1+	11.6+	Cross South Fork Coal Creek.
0.1+	11.75	Crossroad. TURN RIGHT (west).
0.5+	12.25+	Cross South Fork Coal Creek.
0.95	13.2+	T-road intersection. TURN RIGHT (north) (3140N 1800E)
0.6+	13.8+	STOP: 1-way; T-road intersection (3165N 1760E). TURN LEFT (southwest).
0.85	14.65+	To the right is a pre-reclamation law strip mined area, that is, it was only partially leveled.
0.85	15.5+	Prepare to turn right.
0.1	15.6+	T-road intersection from right just before the blacktop curves to the left (3080N 1610E). TURN RIGHT (northerly).
0.3	15.9+	We are crossing some of the rounded off spoil of the Midland Electric Coal Company/Peabody Coal Company.
0.75	16.65+	To the right across the fence and the highwall pond is the a highwall from the former mining operation. Illinoian till is exposed at the top with a covering of Wisconsinan loess. The upper portion of the Illinoian till is stained a pronounced reddish-brown color, the Sangamon Soil.
0.15+	16.8+	Cross South Fork Coal Creek. You will CONTINUE AHEAD for 3 miles.
1.3+	18.1+	Notice that some of the ravines cutting back into the unmined upland are quite steep-walled with bottoms showing very steep gradients. Mining established new base levels which control the depth to which streams can lower their channels locally. Headward growth of the streams, as well as rapid


Middle Grove
(Middlegrove)
CHICAGO
PRIVATE
STRIP MINED AREA
Coal Creek
3
F
1 mi
1½ km

Miles to Next Point	Miles from Start	
		downcutting of their channels, will occur unless concrete weirs and grass waterways are installed to slow down the erosion process.
0.3+	18.45	Cross Coal Creek
1.0	19.45	This surface-mined area has been reclaimed according to the provisions of the strip mine reclamation law and is now back into productive farm use.
0.9+	20.35+	STOP: 2-way; crossroad (3550N 1600E). CAUTION: fast traffic. TURN RIGHT (east) on SR 116. You are about 80 feet lower in surface elevation at this turn than you were at Stop #2.
0.75+	21.1+	To the left is the office building and former site of the tipple for the old Midland Electric Coal Corporation. CONTINUE AHEAD (east).
0.5	21.6+	Prepare to turn right.
0.15-	21.75	TURN RIGHT (south) and park in the visitor parking area of the Rapatee Mine of Midland Coal Company. You MUST have permission to enter this property.

STOP 3. Visit to active surface mine [NW 1/4 NE 1/4 NE 1/4 SW 1/4 Sec. 1, T. 8 N., R. 3 E., 4th P.M.; Farmington West 7.5-minute Quadrangle (40090F1)].

According to a letter dated April 28, 1988, General Superintendent R. D. Gilstrap of Midland Coal Company reported,

> "The geographical area that comprises Rapatee Mine includes much of what was once Midland Electric Coal Corporation's Middlegrove Mine, started in the early 1930s, and closed by Peabody Coal Company in 1968. Midland Electric mined the more shallow coal in the area, both Illinois No. 5, and Illinois No. 6 coal seams. The No. 5 coal lies approximately fifty to sixty feet below the No. 6 seam. The two seams are separated by hard gray shale and sandstone which must be blasted to facilitate stripping. At the time Midland Electric was in operation, the machinery available limited the depth that could be strip mined to about fifty-five feet, so there are many areas where either seam was mined to that depth, and then the area abandoned. The coal reserves available to present-day mining is much deeper and in many cases we are re-mining areas for No. 5 coal, where the upper, No. 6 seam has been removed. The present pit where the 1570 is working is a typical example.

Rapatee Mine employs two stripping draglines to uncover coal in two separate areas. One pit is north of Ill. Rte. 116 in Knox County, and the other, larger pit is south of Rte 116 in Fulton County. Both pits produce No. 5 coal of very similar quality.

Strip mining is a relatively simple operation basically. Prospect drills drill small holes through the soil and shales down to the level of the coal to locate the coal seam. After an area is designated for mining, extensive engineering is required to address potential problems related to hydrology, land use and reclamation. State permits must be obtained and reclamation bonds posted. The top soil is then removed and stored for later replacement, drainage established through sedimentation ponds, and electrical power distribution established.

The stripping machines uncover a "strip" of coal, loading shovels load the coal into bottom dump coal haulage trucks, which transport the coal to the preparation plant where it is washed and sized, and loaded into trucks or railroad cars for delivery to the customer. As the stripping machine progresses it deposits the overburden removed into the area vacated by the previous cut of coal. As one can see by observing the waste dump area, the shale and rock are deposited low in the dump, and the glacial till, or in today's situation, the No. 6 coal overburden, is placed on top of the dump to facilitate plant growth.

After mining is completed, and within four spoil ridges of the active pit, rough grading is completed and within a maximum of 15 months from first disturbance, the top-soil is replaced. The land is then planted in legumes and a support crop such as wheat to prevent erosion and to loosen the root media in preparation for row-crop planting later.

Traditionally, the stripping machines are sized according to the bucket capacity in cubic yards. Rapatee's small machine is a model 480 W, manufactured by Bucyrus-Erie Company in South Milwaukee, Wisconsin.

Boom length	195 feet
Bucket capacity	14 cu. yd.
Base	36 feet dia.
Bearing pressure (tub)	10.5 lbs./sq. in.
Crew members	2 per shift

The larger machine is a model 1570 W, walking dragline, very similar to the 480, also made by Bucyrus-Erie, but much larger.

Boom length	295 feet
Bucket capacity	78 cu. yd.
Base	66 feet dia.
Bearing pressure	14.2 lbs./sq. in.
Crew members	4 per shift

The loading shovel is a 1600 P & H, with a 12 cu. yd. bucket.

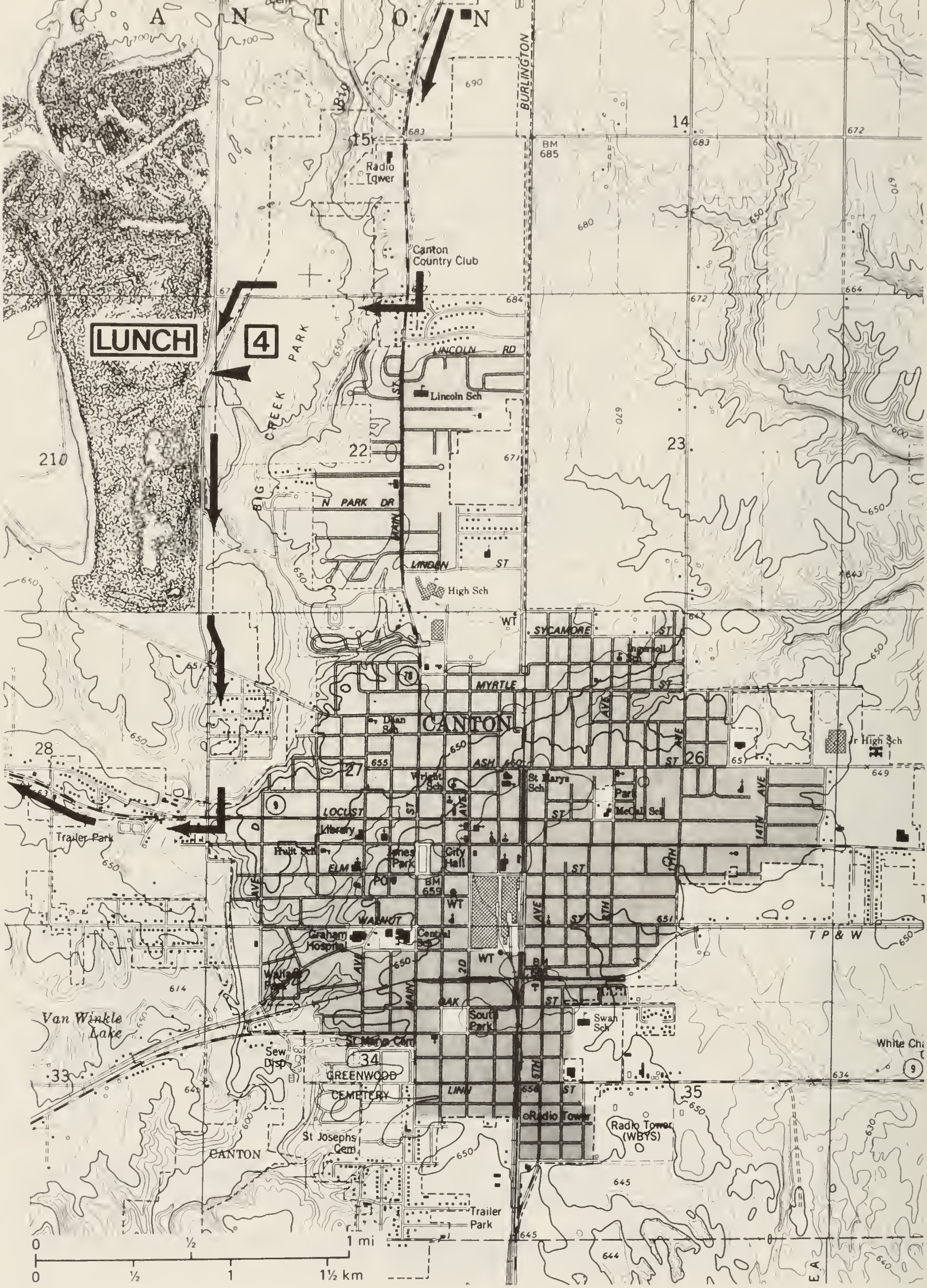

29
28
Gilchrist
27
Coal Creek
Dunkard Cem
Hill Cem
West Branch Copperas Creek
32
33
34
Big Creek
Industrial Waste
Pond
Norris
Radio Tower
CANTO
WT
PRIVATE
5
4
3
Brereton
BM
712
8
10
NORTHERN
BURLINGTON
Johnson
Cem
CANTON
0
½
1 mi
0
½
1
1½ km

The haulage trucks are 120 ton capacity, bottom dumps, made by K. W. Dart Manufacturing Company.

We use Caterpillar tractors and scrapers, and much auxilary equipment made by various manufacturers.

Rapatee Mine employs 89 hourly workers, and 22 salaried persons, including clerical and warehouse personnel."

Miles to Next Point	Miles from Start	
0.0	21.75	Leave Stop 3 and TURN RIGHT (east) on SR 116.
0.55	22.3	CAUTION: Enter hamlet of Middle Grove. CONTINUE AHEAD (east).
1.4	23.7	Prepare to turn right.
0.1+	23.8+	Crossroad (3550N 1950E). TURN RIGHT (south) on gravel road.
0.2+	24.05+	CAUTION: Single Northwestern Railroad track, formerly Minneapolis & St. Louis (M & St. L). CONTINUE AHEAD (south). The old National Coal Mining Company (later became Dorthel Coal Co. #3) shaft was located about 100 feet south of the tracks and 855 feet west of the road. The shaft was 100 feet deep to 52" of Springfield Coal.
0.2	24.25+	This area was strip mined in the 1930s. You will go south for about 5 miles.
2.3+	26.6	STOP: 2-way; crossroad (3275N 1960E). CONTINUE AHEAD (south and east).
2.55	29.15	The highest surface elevation on the field trip lies between us and Stop #2, 0.5 mile to the right (west).
0.25+	29.4	STOP: 1-way; T-road intersection with Fairview-Norris Road (3000N 2000E). TURN LEFT (east).
0.65	30.05	Abandoned Consolidation Coal Company's Norris Mine site to right. CONTINUE AHEAD (east).
0.45	30.5+	CAUTION: Rough abandoned BN mine spur. CONTINUE AHEAD (east).
0.35+	30.85+	Cross Big Creek headwaters. CONTINUE AHEAD with CAUTION into village of Norris.
0.25-	31.1+	STOP: 2-way. TURN RIGHT (south) on Main Street.



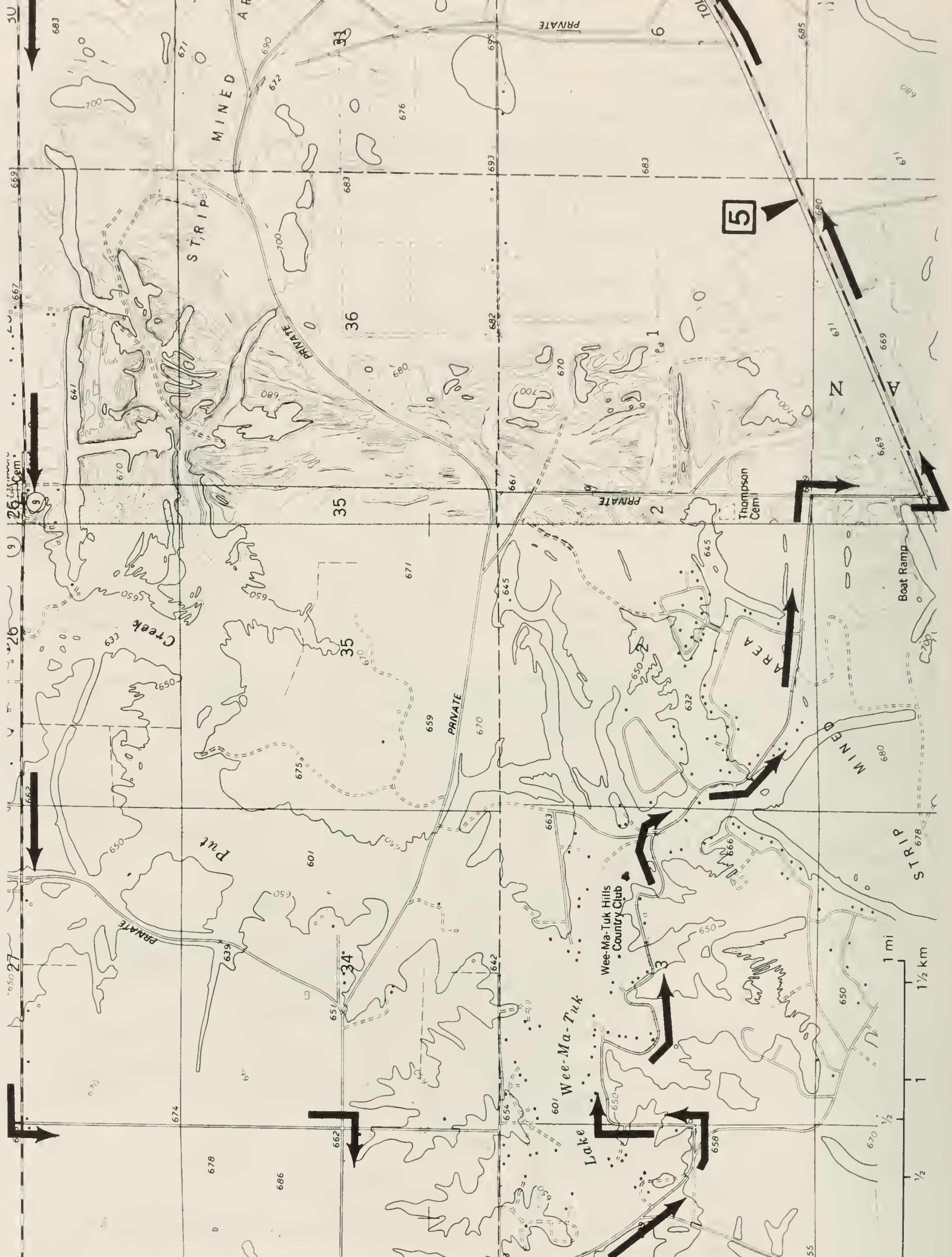
C A N T O N
LUNCH
4
BURLINGTON
Radio Tower
Canton Country Club
LINCOLN RD
Lincoln Sch
BIG CREEK PARK
N PARK DR
MAIN ST
LINDEN ST
High Sch
SYCAMORE ST
MYRTLE ST
CANTON
ASH ST
LOCUST ST
Library
Hulit Sch
ELM
Jones Park
City Hall
PO
WALNUT
Graham Hospital
Central Sch
Wallace Park
OAK ST
South Park
Swan Sch
St Marys Cem
Sew Disp
GREENWOOD CEMETERY
LINN ST
Radio Tower
Radio Tower (WBYS)
St Josephs Cem
CANTON
Trailer Park
Trailer Park
Van Winkle Lake
Jr High Sch
McCall Sch
St Marys Sch
Wright Sch
Ingersoll Sch
T P & W
White Cha
14
15
22
23
26
27
28
33
34
35
210
0
½
1 mi
0
½
1
1½ km

Miles to Next Point	Miles from Start	
0.3+	31.45+	STOP: 1-way; T-road intersection with SR 78 (2970N 2170E). TURN RIGHT (southwesterly and south) with CAUTION.
2.35	33.8	CAUTION: Enter City of Canton.
0.15	33.95	Prepare to turn right.
0.1+	34.05+	TURN RIGHT on Lakeland Drive.
0.1+	34.2+	Cross Big Creek.
0.35+	34.55+	TURN LEFT (southwesterly).
0.25+	34.85	TURN RIGHT (west) at the entrance to Lakeland Park. This is lunch stop. (Mileage figures will resume at the entrance after lunch.)

STOP 4. Lunch at reclaimed strip-mined area. Entrance [SE 1/4 SE 1/4 NE 1/4 NE 1/4 Sec. 21, T. 7 N., R. 4 E., 4th P.M.; Canton 7.5-minute Quadrangle (4009E1)].

This land was mined by Consolidation Coal Company's Norris Mine. The property was donated to the Canton Park District for Lakeland Park. A special children's park dedicated to NASA's 100th astronaut, Steve Nagle, is located here.

Miles to Next Point	Miles from Start	
0.0	34.85	Leave Stop 4 and TURN RIGHT (south).
0.9+	35.75+	STOP: 2-way; offset crossroad (2885N 2100E), West Vine Street. Jog left and then right. CONTINUE AHEAD (south) on Avenue F.
0.4+	36.15+	Cross Big Creek.
0.05	36.25+	STOP: 2-way; crossroad. TURN RIGHT (west) on West Locust (SR 9).
0.05+	36.3+	Cross Big Creek.
0.95+	37.25	Leave Canton City Limits.
0.45+	37.7	Ingersoll Airport Road to right. CONTINUE AHEAD (west).



STRIP MINED AREA
PRIVATE
Put Creek
Lake Wee-Ma-Tuk
Wee-Ma-Tuk Hills Country Club
Thompson Cem
Boat Ramp
5
0 ½ 1 mi
0 ½ 1 1½ km

Miles to Next Point	Miles from Start	
0.4	38.1	Construction to left is for the State prison.
0.15+	38.25	CAUTION: crossroad (2550N 1900E). Spoon River College road to left. CONTINUE AHEAD (west) on SR 9.
0.45	38.7	The area to the left was strip mined by Truax-Traer Coal Company in the mid-1960s; this later became Consolidation Coal Company.
1.6	40.3+	Cross Put Creek.
0.15+	40.45	To the right is a coal "blossom" of Springfield Coal. The new road cut has a sloped bank that was covered with soil in order to establish a sod cover for erosion protection. Some slumping of materials has re-exposed part of the coal. Because it is so highly weathered, the coal is called "blossom".
0.9	41.35+	The area to the right was strip mined in the late 1950s. Within about a year after it was mined, Truax Traer Coal Company had leveled it and planted crops on an experimental basis to see what sort of yields they would get and also to prove that it was possible to raise crops on this strip-mined land.
0.7	42.05+	Prepare to turn left ahead at Junction SR 9 and SR 97.
0.15+	42.2+	CAUTION: on-coming traffic is fast. TURN LEFT (south) on the oiled road. You are turning from 2550N onto 1500E
0.5	42.75+	To the right is the old gob pile (mine refuse) from the coal washing plant of the Truax Traer Red Ember Mine. The tipple was about 0.7 mile west-southwest of here. The Truax-Traer Coal Company's Flatt #2 Mine began producing Springfield Coal in 1935. The name was changed to Red Ember in 1944. A bucket-wheel excavator and stripping shovel with a bucket capacity of about 75 cubic yards were used to uncover the coal, which averaged about 54 inches thick. The mine was abandoned in September, 1969, after producing 43,950,835 tons of coal. Of this total, a little more than 820 thousand tons was Herrin Coal mined during its last year or so of operation.
0.45	43.2+	Crossroad. TURN RIGHT (west) on gravel.
0.45+	43.7	CAUTION: Crossroad. No stop signs. TURN LEFT (south).

Miles to Next Point	Miles from Start	
0.8	44.5	Cross Lake Wee-Ma-Tuk spillway and dam. The dam was placed across Put Creek to impound water for the Red Ember Mine tipple.
0.15+	44.65+	BEAR LEFT at the Y-intersection and ascend hill.
0.2+	44.9+	BEAR LEFT (east) at intersection and stay on the main blacktop through this area, Wee-Ma-Tuk Hills.
0.1	45.0+	The curve to the left is around the west edge of an 18-hole golf course. Part of this golf course is developed on stripped land and part of it is developed on unstripped land. The road will cross several small dams in the area, a series of small strip mine ponds that drain by gravity into Lake Wee-Ma-Tuk. The development of homesites around the lake began during the mid 1950s.
1.3-	46.3+	STOP: T-road intersection. To the right is the golf course pro shop. To the left at about 10:30 o'clock is Wee-Ma-Tuk Hills Country Club. TURN RIGHT (south and then east).
0.25+	46.55+	CAUTION: intersection on curve. BEAR RIGHT (southeasterly). Stay on rough main oiled road.
1.3	47.85+	T-road intersection (2300N 1700E). TURN RIGHT (south) on the blacktop.
0.3+	48.2	CAUTION: single guarded Santa Fe railroad track, formerly Toledo Peoria and Western (TP&W) railroad.
0.05-	48.2+	STOP: 1-way; T-road intersection with Canton-Cuba macadam (2265N 1700E). TURN LEFT (northeast). NOTE: the headquarters of Prairie Plan/MSD Fulton County is located 1.3 miles southwest from this intersection.
1.0	49.2	Park along right side of roadway as far off on shoulder as you can safely. CAUTION: fast traffic--stay off pavement.

STOP 5. Discussion of Prairie Plan reclamation project [SW 1/4 SE 1/4 SE 1/4 SE 1/4 Sec. 1, T. 6 N., R. 3 E., 4th P.M.; Canton 7.5-minute Quadrangle (40090E1)].

During the late 1960s, long before any mined-lands legislation had been passed into law, Fulton County officials had become increasingly concerned about the erosion of the county's tax base because surface-mining was affecting about

3000 acres (4 2/3 square miles) annually (Hall, et al, 1984). There were few incentives on the part of mine operators to do much reclamation. Although a few mining companies were conducting some reclamation projects, there were still large acreages of older stripped lands that were left in their extremely roughened condition. These areas would support only scrubby vegetation of little or no value.

With new environmental issues seemingly arising each day, county officials reasoned that if the land could be nearly leveled and if organic material could be incorporated into the upper part of the leveled land, it should be possible to develop a growing medium and eventually a soil. This would increase the productivity of the acreage, which in turn would increase the land's value and the county's tax base.

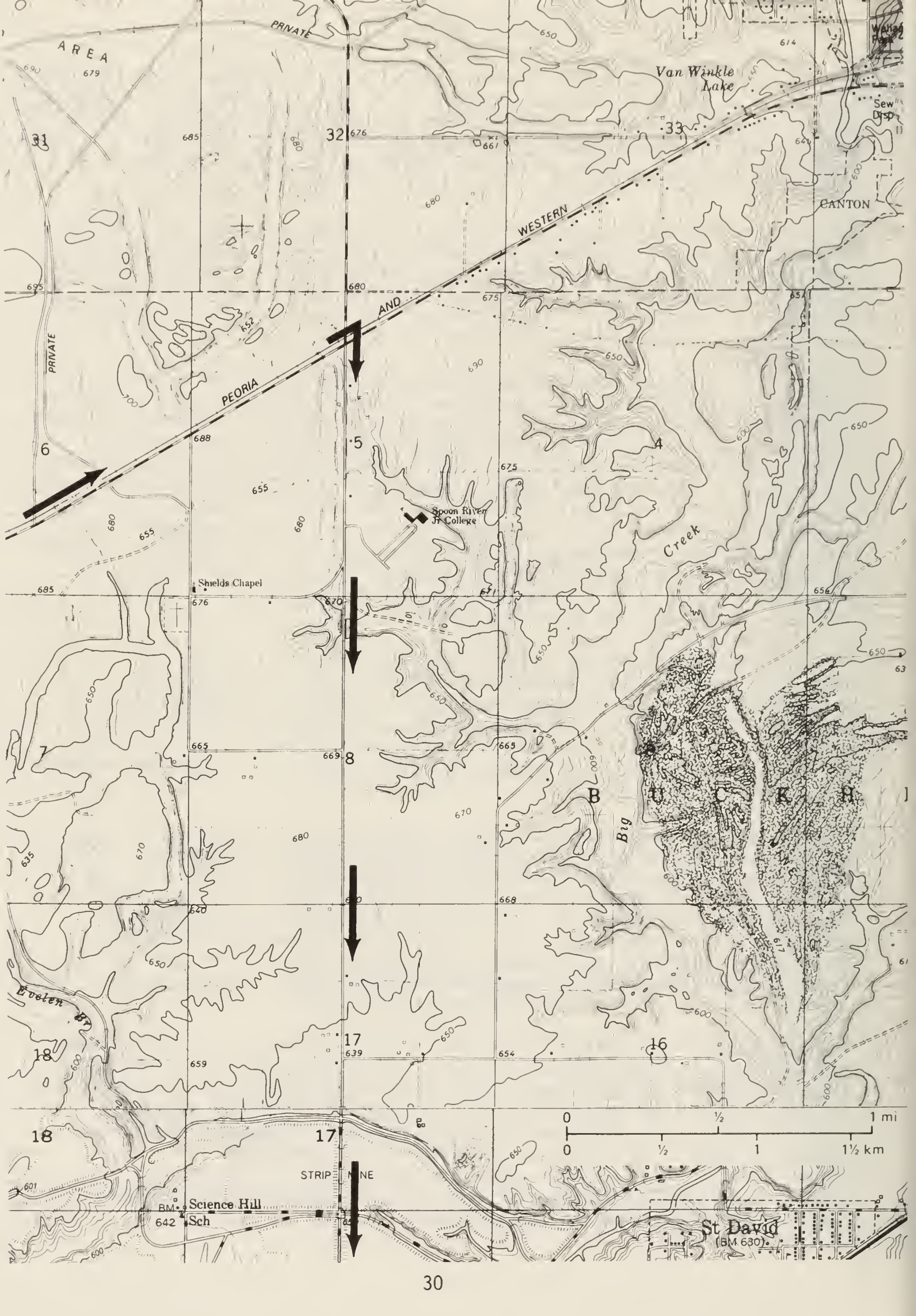
Fulton County officials began talks with Metropolitan Sanitary District of Greater Chicago (MSD) officials, who had a disposal problem because of large quantities of sewage solids that were collected each day. MSD collects and treats wastewater not only from the City of Chicago, but also from 124 suburbs. With a population of more than 5 million people in the metro area, and an industrial waste load that is equivalent to another 4.5 million people, about 700 dry tons of organic solids are generated and collected daily (Hall, et al, 1984). These materials had been stored as liquids in lagoons, air dried and stored at dump sites, or heat dried and sold as fertilizer. Land application of sludge had been considered and tried on a small scale, but adequate acreages in large enough tracts for the project either were not available in the metro area or too expensive.

Talks between county officials and MSD resulted in "The Prairie Plan," a long-range program for reclaiming strip-mined land through the application of organic matter in stabilized sewage solids. This part of Fulton County is about 190 miles southwest of Chicago. MSD purchased 5,461 acres from a private owner in the fall of 1970 and began site preparation early in 1971. MSD now owns more than 15.5 thousand acres of which 5,480 acres are designated as recycle fields.

Anaeorobically digested sludge averaging 6% solids was barged from southwestern Chicago to Liverpool on the Illinois River beginning in 1971. The sludge then was pumped overland for nearly 11 miles through a 20-inch pipeline to holding basins located a little more than a mile south from here. Sludge was then piped to fields for application by spraying, by spreading and incorporation with an offset disc harrow built for the construction industry, or by using a slotted pipe which allows the liquid fertilizer to flow out onto the ground and down gentle slopes. Barge shipment stopped in March 1983 because of increased costs.

The lagoons are being dewatered and dried out. The most satisfactory means for applying the dried sludge is by using a high-flotation type fertilizer spreader. There is not as much compaction of the soil structure as when done by a truck/bulldozer/tractor and disc combination. The high flotation spreader applies the sludge more uniformly and is not constrained by the weather as much as are other types of mechanical equipment.

After barge shipments stopped, MSD has used railroad cars experimentally to transport the dry solids to Fulton County.



AREA
PRIVATE
Van Winkle Lake
CANTON
PEORIA AND WESTERN
Spoon River Jr College
Shields Chapel
Big Creek
BUCKHEART
Evelen Br
STRIP MINE
Science Hill Sch
BM 642
St David
(BM 630)
0 ½ 1 mi
0 ½ 1 1½ km

The Illinois Environmental Protection Agency (IEPA) permits up to 25 tons of dry solids to be applied per acre annually. At present, the applications are done on a three-year cycle. Sludge is applied for two years while a cash crop is grown during the third year to utilize the incorporated nitrogen.

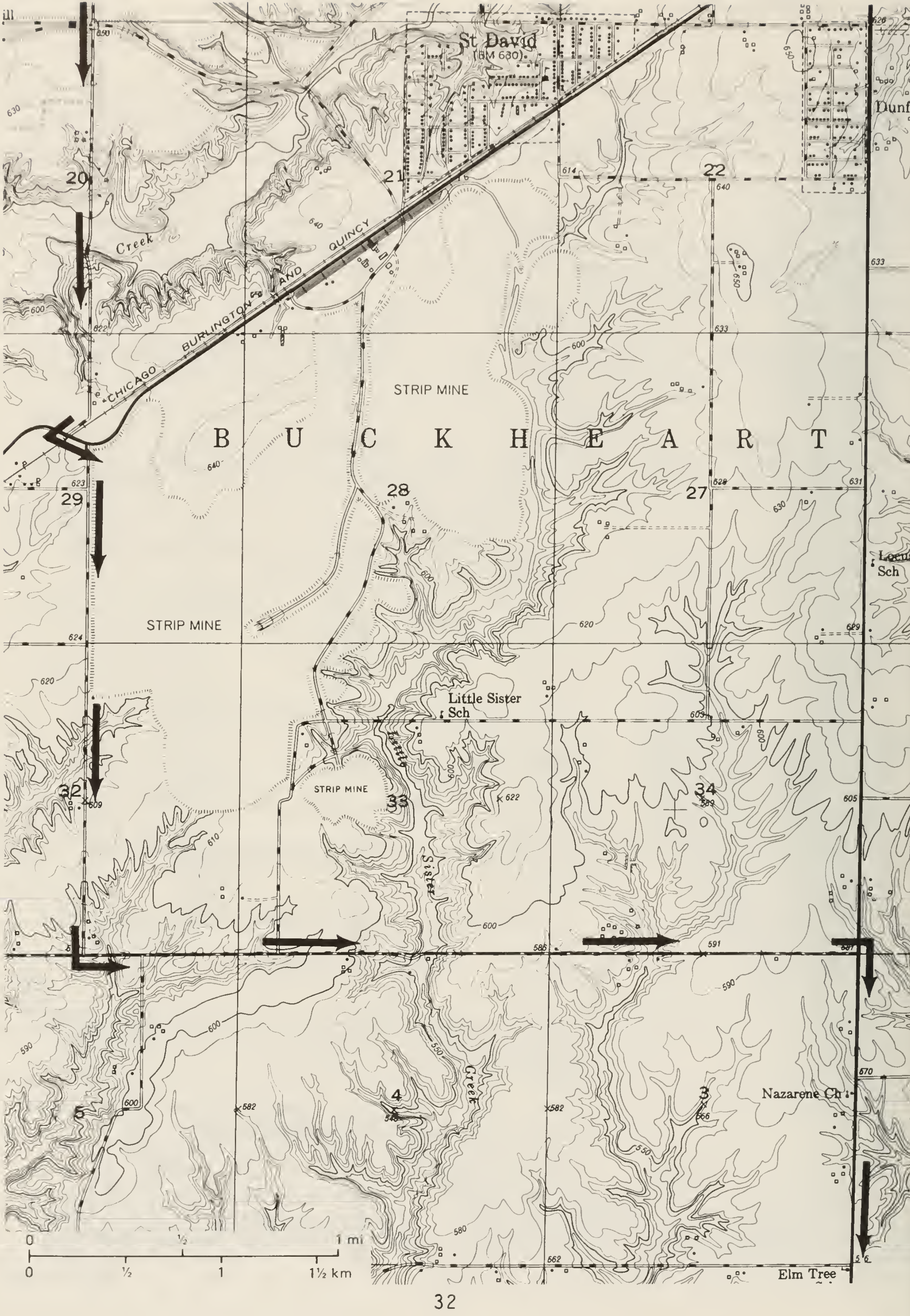
Sludge applied to fields increase crop yields but not to the extent hoped for. During the 11-years (1972-1982), corn varied from 15 to 108 bushels per acre (planted each year), wheat varied 13 to 55 bushels per acre (planted 7 years, lost 1 because of ice storms), and soybeans varied from 8 to 18 bushels per acre (planted 2 years).

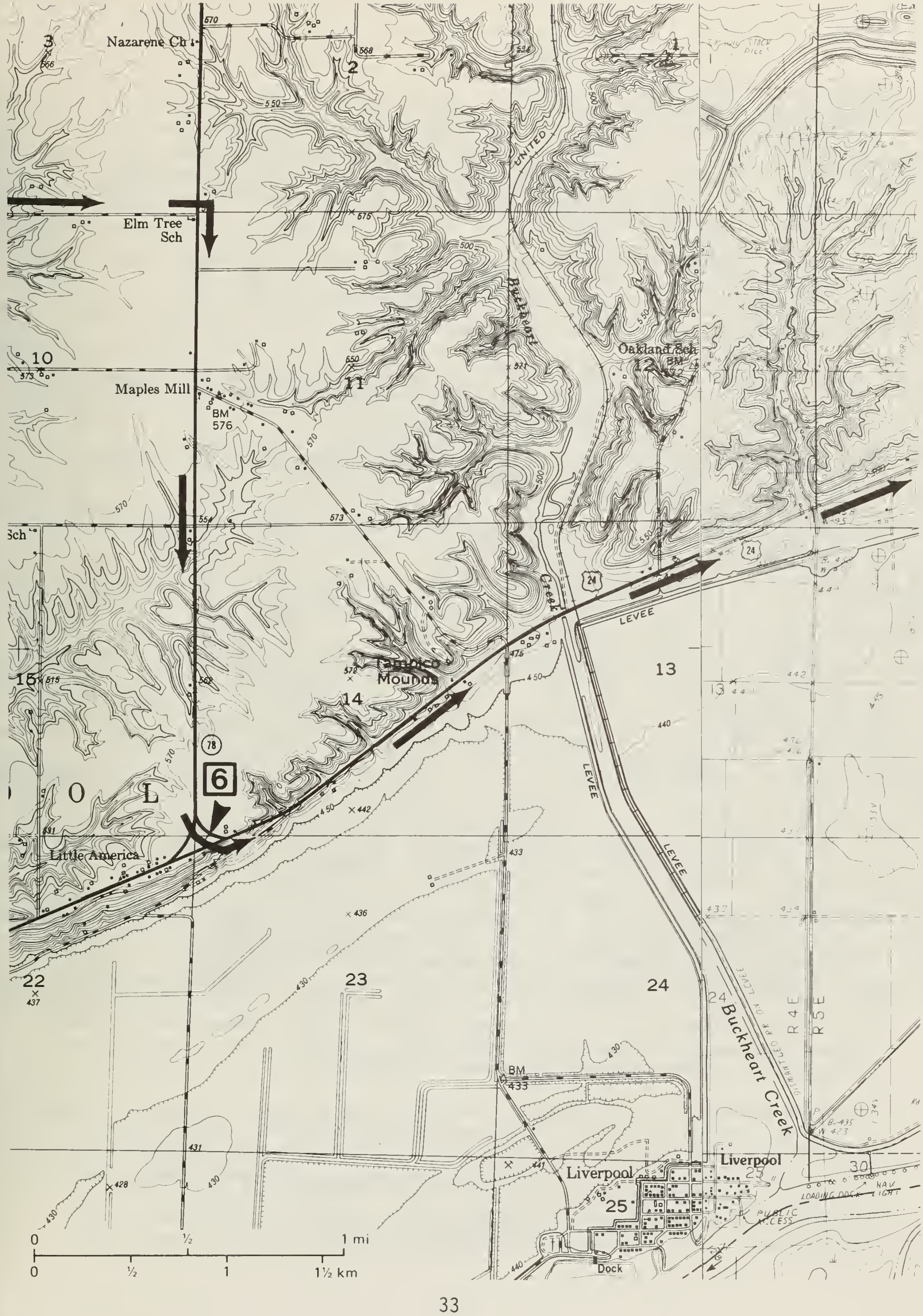
The fields are surrounded by berms, terraces and drainageways to conduct surface runoff to retention basins that are designed to hold the estimated runoff from a 100-year frequency 24-hour duration storm. The field in front of us is an example of reclaimed mined-land.

Monitoring wells were installed in the holding basin area. Each month 25 constituents are tested from samples taken from each of 25 wells, 11 streams, 10 lakes, 58 retention basins and 1 spring with no indication of groundwater pollution. The results are published monthly.

In addition to reclaiming land productivity, the Prairie Plan has provided recreation, conservation and wildlife preservation areas.

Miles to Next Point	Miles from Start	
0.0	49.2	Leave Stop 5 and CONTINUE AHEAD (northeast).
1.6	50.8+	Prepare to turn right.
0.1+	50.9+	TURN RIGHT (south) on bumpy blacktop (2385N 1950E).
0.55+	51.5+	Entrance drive on left to Spoon River Community College.
0.1+	51.6+	r-intersection. CONTINUE AHEAD (south) on gravel.
2.1+	53.7+	CAUTION: crossroad (2100N 1950E). CONTINUE AHEAD (south).
0.7	54.45-	Cross Big Creek. Note the size of this valley and compare it with the valley just west of SR 78 at mileage 34.2+.
0.6+	55.05+	STOP: 1-way. CAUTION: TURN LEFT (southeast) on SR 100 and immediately cross BNRR tracks.
0.05+	55.15+	TURN RIGHT (south) on gravel road. NOTE: the site of the abandoned Truax-Traer Coal Company's Little Sister Mine is 1.1 miles northeast on SR 100 from this junction. Springfield Coal ranging from 4'6"


St David
(BM 630)
Dunf
CHICAGO BURLINGTON AND QUINCY
Creek
STRIP MINE
B U C K H E A R T
STRIP MINE
Little Sister
Sch
STRIP MINE
Little
Sister
Creek
Locus
Sch
Nazarene Ch
Elm Tree
20
21
22
28
27
29
32
33
34
5
4
3
0
½
1 mi
0
½
1
1½ km



Nazarene Ch
Elm Tree Sch
Maples Mill
BM 576
Buckheart Creek
UNITED
Oakland Sch
Tampico Mounds
LEVEE
Little America
6
78
24
R4E
R5E
Liverpool
Dock
LOADING DOCK
NAV LIGHT
PUBLIC ACCESS
0 ½ 1 mi
0 ½ 1 1½ km

Miles to Next Point	Miles from Start	
		to 5'1" thick was strip-mined from beneath 65 to 95 feet of cover. Total coal mined amounted to 22,104,177 tons. The mine operated from 1936 until 1967.
1.6+	56.8-	STOP: 1-way; T-road intersection (1800N 1950E). TURN RIGHT (east).
1.05+	57.85+	Cross Little Sister Creek.
1.15	59.0+	To the left at about 10:30 o'clock is the Duck Creek Power Plant of CILCO (Central Illinois Light Company).
0.25+	59.3	STOP: 1-way; T-road intersection (1800N 2200E) SR78. TURN RIGHT (south).
1.55	60.85+	T-road from left, hamlet of Maples Mill. CONTINUE AHEAD (south).
1.25-	62.1	CAUTION: Approaching hamlet of Little America. Prepare to turn left at Y-intersection of SR 78 and US 24.
0.1+	62.2+	BEAR LEFT (southeast) and prepare to stop.
0.05+	62.3	CAUTION: Park well off the highway on the inside of the Y. Walk to south but do NOT cross US 24.

STOP 6. Discussion of Illinois River Valley from top of bluff [NE extended NW 1/4 NW 1/4 NW 1/4 Sec. 23, T. 5 N., R. 4 E., 4th P.M.; St. David 7.5-minute Quadrangle (40090D1)].

HISTORY OF ILLINOIS VALLEY. The junction is situated at the crest of the bluff overlooking the broad Illinois River valley. In preglacial times the confluence of the Mahomet Valley (pre-glacial Ohio or Teays) and the pre-glacial Mississippi was about 26 miles east-southeast of here in the broad lowland (fig. 5). Each valley was cut down to below 300 feet altitude, about 130 feet below the present river level (Horberg, 1950). These were the two largest valleys of the eastern United States, draining areas as remote as Minnesota or southern Manitoba and North Carolina.

This broad and deep lowland did not wholly fill with glacial sediment although it was invaded by glaciers at least during the Illinoian. Pre-Illinoian glaciation of the valley, if it took place, is poorly known, for there are few borings in this part of the alluvial valley and an ample groundwater supply is obtained from outwash sands of Wisconsin age. There is reason to believe that, whereas the area west of the river experienced Pre-Illinoian glaciations, the valley may not have been glaciated at any of these times.

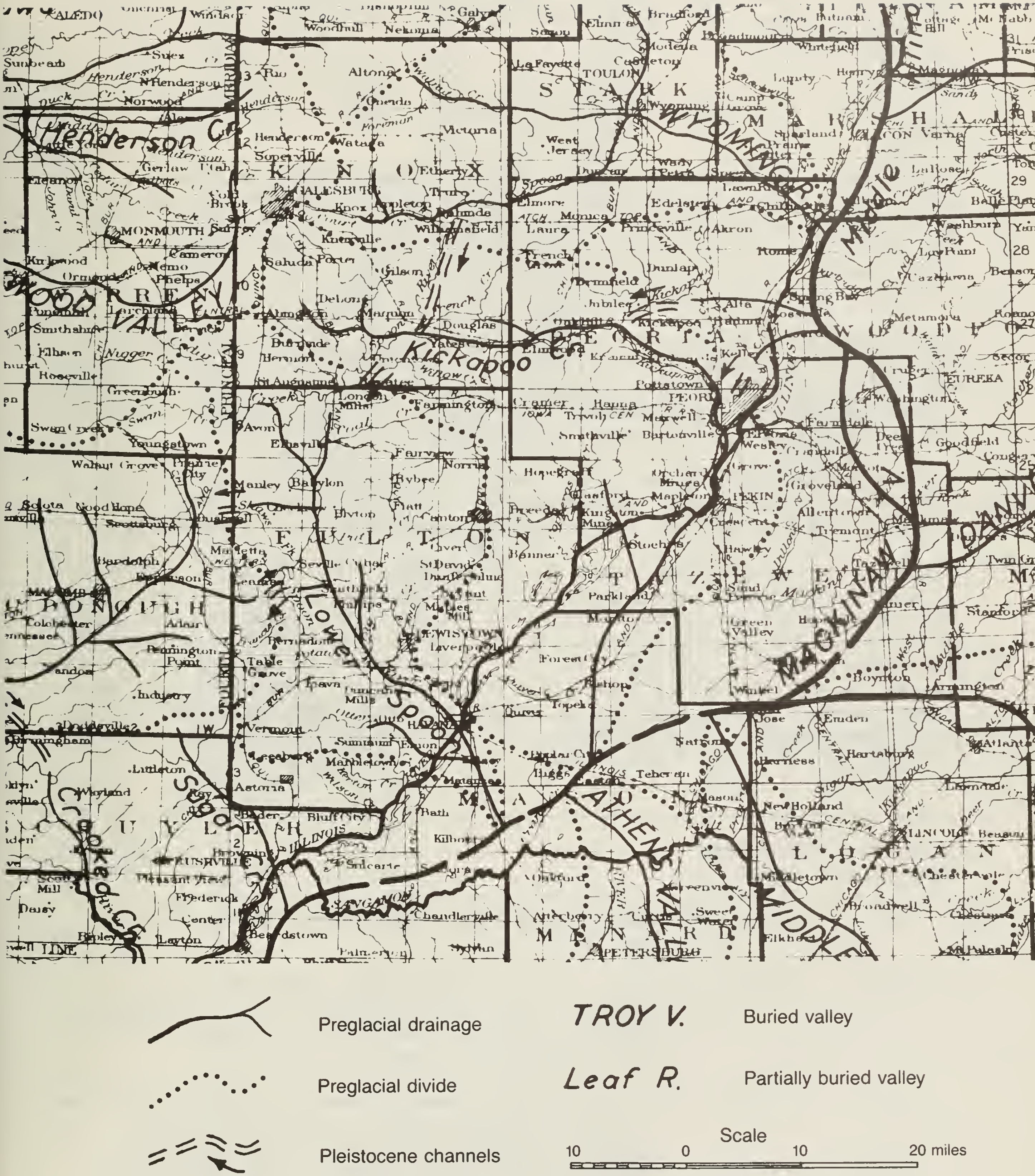


Figure 5 Preglacial drainage of Canton area.

Northeast of here, where the border of Wisconsin glaciation covers the two valleys, they have been wholly buried, and their courses are known only from subsurface studies.

During the middle of the Illinoian, the valley was invaded by a lobe of glacial ice. This stage left a marked impress on the drainage pattern of the area.

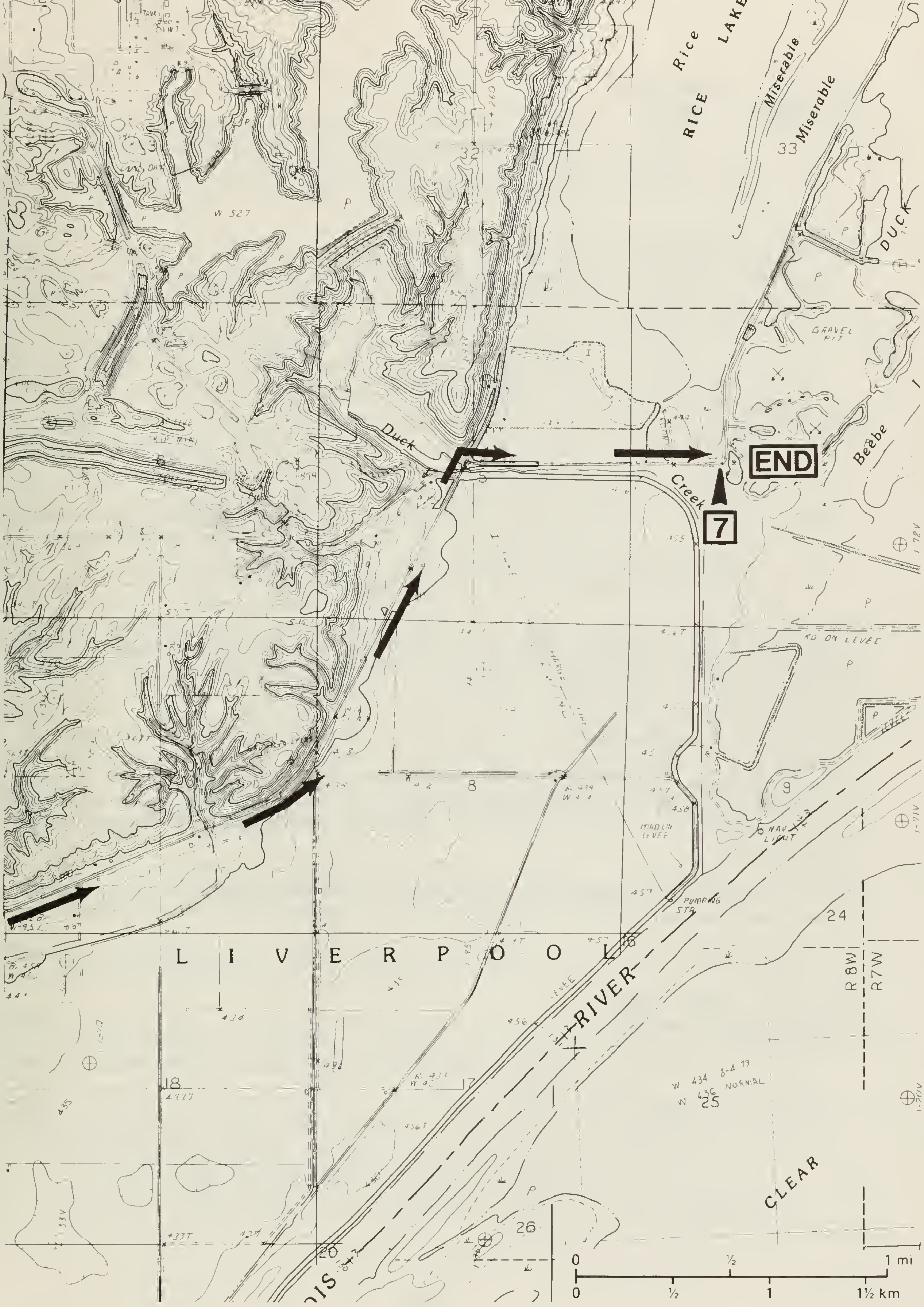
Subsequently, during Woodfordian time, when the Bloomington moraine was built near Peoria, a great fan of outwash filled this valley from Peoria to below Beardstown, damming the river and forming glacial Lake Illinois behind this fan as the ice front retreated. The fan dammed many tributary streams, like Spoon River. The lake was drained in late Woodfordian time, probably initiating the present valley along the northwestern margin of the old valley.

Later, during the melting of the Valparaiso glacier about 16,500 years ago, the valley was occupied by a great flood, the Kankakee glacial torrent (Ekblaw and Athy, 1925). This flood formed a system of branching channels and built elongate sand bars, the sand ridges of Mason County, and developed the present Illinois Valley on the northwest border of the old broad valley.

Still later, the upper Great Lakes drained a flood of clear water into the Illinois River through the Chicago outlet river. This deepened the valley further, with a meandering regimen still recognizable in aerial photographs.

Since the last Great Lakes waters drained naturally into the Illinois River, it has been sluggish, with a gradient of only about 3 inches per mile. It has been an aggrading stream with more actively aggrading tributaries. Such bends as the river now has result from fans of alluvium crowding the river against the opposite bank, as the Farm Creek fan at Peoria and the Spoon River fan at Havana. A series of large flood-plain lakes, not all of the oxbow type, have formed between these fans. Some of the lakes have been artificially drained, like Thompson Lake, which was formerly in the part of the valley about 6 miles southwest near Dickson Mounds Museum.

Miles to Next Point	**Miles from Start**	
0.0	62.3	Leave Stop 6 and CONTINUE AHEAD (southeast and east).
0.05-	62.35-	STOP: 1-way (1500N 2200E). TURN LEFT (east) on U.S. 24. Use EXTREME CAUTION. Traffic is fast and visibility is poor from the left. You are on the east edge of Little America.
1.1	63.45+	Liverpool Road, County Highway 8. To the left about a little over one-tenth of a mile up the slope is an exposure of Springfield Coal in the roadcut. CONTINUE AHEAD (northeasterly). You may notice a number of little gob piles in the woods to the left--the sites of former dog-hole mines.


Rice
LAKE
RICE
Miserable
Miserable
DUCK
GRAVEL PIT
Duck
Creek
END
7
Beebe
RD ON LEVEE
PUMPING STA
NAV LIGHT
L I V E R P O O L
RIVER
CLEAR
R 8W
R 7W
0
½
1 mi
0
½
1
1½ km

Miles to Next Point	Miles from Start	
1.1	64.55	To the left, highbank of Canton Shale occurs above the Springfield Coal. There was a small amount of strip mining in that hollow in the early days.
2.05	66.6+	Prepare to turn right.
0.1+	66.7+	T-road from right. TURN RIGHT (east) at the sign pointing to the Duck Island Sand and Gravel Company.
0.8+	67.55+	CAUTION: Office area of Duck Island Sand and Gravel Company. You MUST have permission to enter this property. Follow directions in parking.

STOP 7. View of sand and gravel pit and discussion about the materials origin [Office: SE 1/4 SW 1/4 SE 1/4 NW 1/4 Sec. 4, T. 5 N., R. 5 E., 4th P.M.; Duck Island 7.5-minute Quadrangle (40089D8)].

Use EXTREME CAUTION in this area and follow directions. Do NOT climb on the piles. Do NOT throw rocks.

The deposit that is mined here is a remnant of the Wisconsinan Bloomington outwash fan that extended down the valley from Peoria to Beardstown. The fan was considerably modified by the Kankakee Torrent from the melting Valparaiso glacier about 16,500-15,500 years B.P.

The south pit was dredged to a depth of 60 feet. A dragline operates in the present pit to depths ranging from 18 to 35 feet. The sand and gravel passes through a screw classifier, which separates it into various size classes for different purposes, such as concrete sand, mortar sand, and blend sand for black topping. The coarser grades are used for construction aggregate and road gravel.

Quite a variety of igneous and metamorphic rocks are present in the gravel. Some limestone and chert fragments are fossiliferous.

Miles to Next Point	Miles from Start	
0.0	67.55+	Leave Stop 7 and retrace route to the north to the highway.
0.8+	68.35+	STOP: 1-way; T-road intersection (U.S. 24). TURN LEFT to go to Lewistown, Havana, Canton. TURN RIGHT to go to Banner, Pekin, Peoria and Interstate 74. This is the end of the field trip.

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DEPOSITIONAL HISTORY OF THE PENNSYLVANIAN ROCKS

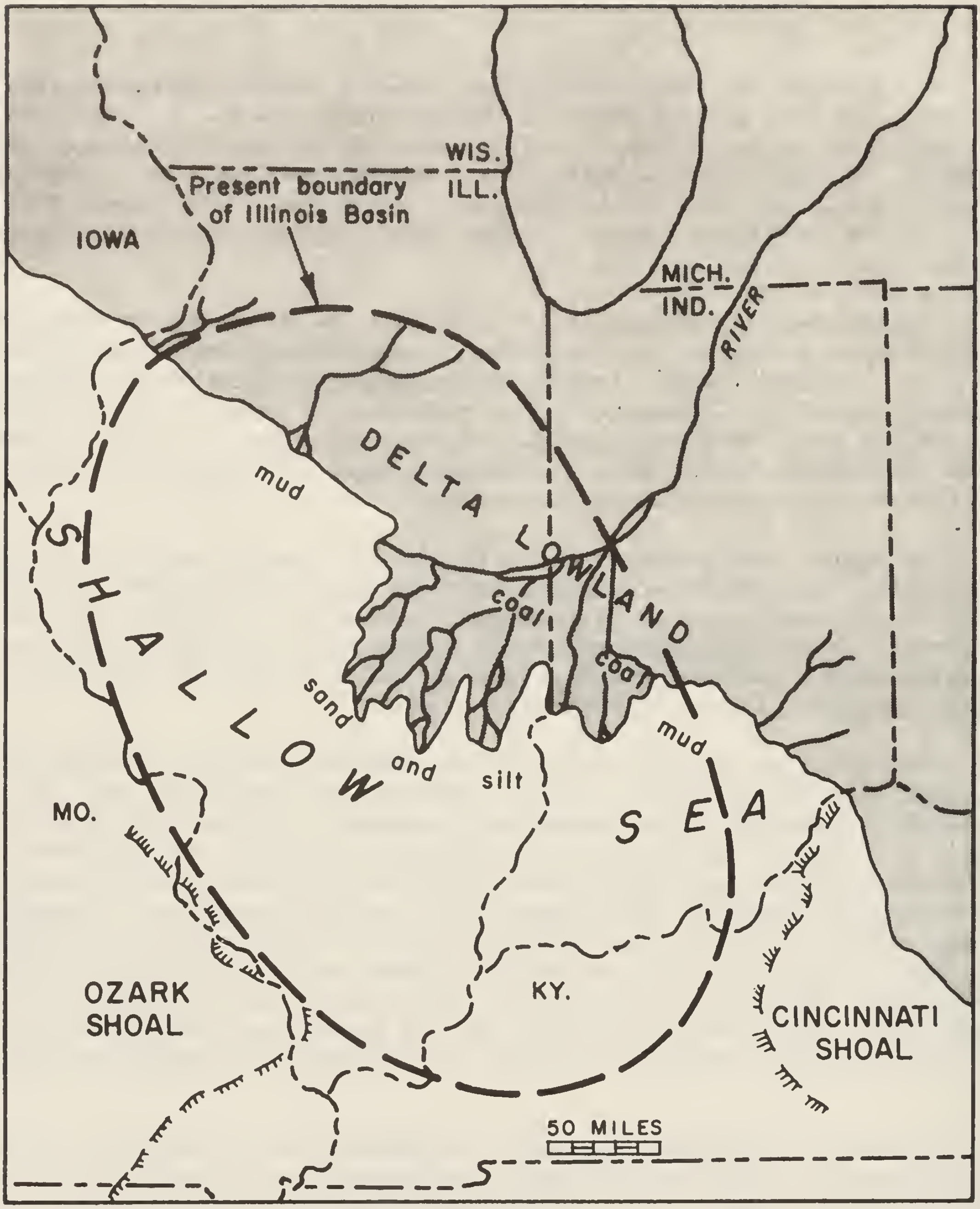
At the close of the Mississippian Period, about 310 million years ago, the Mississippian sea withdrew from the Midcontinent region. A long interval of erosion took place early in Pennsylvanian time and removed hundreds of feet of the pre-Pennsylvanian strata, completely stripping them away and cutting into older rocks over large areas of the Midwest. An ancient river system cut deep channels into the bedrock surface. Erosion was interrupted by the invasion of the Morrowan (early Pennsylvanian) sea.

Depositional conditions in the Illinois Basin during the Pennsylvanian Period were somewhat similar to those that existed during Chesterian (late Mississippian) time. A river system flowed southwestward across a swampy lowland, carrying mud and sand from highlands in the northeast. A great delta was built out into the shallow sea (see paleogeography map on next page). As the lowland stood only a few feet above sea level, only slight changes in relative sea level caused great shifts in the position of the shoreline.

Throughout Pennsylvanian time the Illinois Basin continued to subside while the delta front shifted owing to worldwide sea level changes, intermittent subsidence of the basin, and variations in the amounts of sediment carried seaward from the land. These alternations between marine and nonmarine conditions were more frequent than those during pre-Pennsylvanian time, and they produced striking lithologic variations in the Pennsylvanian rocks.

Conditions at various places on the shallow sea floor favored the deposition of sandstone, limestone, or shale. Sandstone was deposited near the mouths of distributary channels. These sands were reworked by waves and spread as thin sheets near the shore. The shales were deposited in quiet-water areas—in delta bays between distributaries, in lagoons behind barrier bars, and in deeper water beyond the nearshore zone of sand deposition. Most sediments now recognized as limestones, which are formed from the accumulation of limey parts of plants and animals, were laid down in areas where only minor amounts of sand and mud were being deposited. Therefore, the areas of sandstone, shale, and limestone deposition continually changed as the position of the shoreline changed and as the delta distributaries extended seaward or shifted their positions laterally along the shore.

Nonmarine sandstones, shales, and limestones were deposited on the deltaic lowland bordering the sea. The nonmarine sandstones were deposited in distributary channels, in river channels, and on the broad floodplains of the rivers. Some sand bodies, 100 or more feet thick, were deposited in channels that cut through many of the underlying rock units. The shales were deposited mainly on floodplains. Freshwater limestones and some shales were deposited locally in fresh-water lakes and swamps. The coals were formed by the accumulation of plant material, usually where it grew, beneath the quiet waters of extensive swamps that prevailed for long intervals on the emergent delta lowland. Lush forest vegetation, which thrived in the warm, moist Pennsylvanian climate, covered the region. The origin of the underclays beneath the coals is not precisely known, but they were probably deposited in the swamps as slackwater muds before the formation of the coals. Many underclays contain plant roots and rootlets that appear to be in their original places. The formation of coal marked the end of the nonmarine portion of the depositional cycle, for resubmergence of the borderlands by the sea interrupted nonmarine deposition, and marine sediments were then laid down over the coal.



Paleogeography of Illinois-Indiana region during Pennsylvanian time. The diagram shows the Pennsylvanian river delta and the position of the shoreline and the sea at an instant of time during the Pennsylvanian Period.

Pennsylvanian Cyclothems

Because of the extremely varied environmental conditions under which they formed, the Pennsylvanian strata exhibit extraordinary variations in thickness and composition, both laterally and vertically. Individual sedimentary units are often only a few inches thick and rarely exceed 30 feet thick. Sandstones and shales commonly grade laterally into each other, and shales sometimes interfinger and grade into limestones and coals. The underclays, coals, black shales, and

limestones, however, display remarkable lateral continuity for such thin units (usually only a few feet thick). Coal seams have been traced in mines, outcrops, and subsurface drill records over areas comprising several states.

The rapid and frequent changes in depositional environments during Pennsylvanian time produced regular or cyclical alternations of sandstone, shale, limestone, and coal in response to the shifting front of the delta lowland. Each series of alternations, called a cyclothem, consists of several marine and non-marine rock units that record a complete cycle of marine invasion and retreat. Geologists have determined, after extensive studies of the Pennsylvanian strata in the Midwest, that an ideally complete cyclothem consists of 10 sedimentary units. The chart on the next page shows the arrangement. Approximately 50 cyclothems have been described in the Illinois Basin, but only a few contain all 10 units. Usually one or more are missing because conditions of deposition were more varied than indicated by the ideal cyclothem. However, the order of units in each cyclothem is almost always the same. A typical cyclothem includes a basal sandstone overlain by an underclay, coal, black sheety shale, marine limestone, and gray marine shale. In general, the sandstone-underclay-coal portion (the lower 5 units) of each cyclothem is nonmarine and was deposited on the coastal lowlands from which the sea had withdrawn. However, some of the sandstones are entirely or partly marine. The units above the coal are marine sediments and were deposited when the sea advanced over the delta lowland.

Origin of Coal

It is generally accepted that the Pennsylvanian coals originated by the accumulation of vegetable matter, usually in place, beneath the waters of extensive, shallow, fresh-to-brackish swamps. They represent the last-formed deposits of the nonmarine portions of the cyclothems. The swamps occupied vast areas of the deltaic coastal lowland, which bordered the shallow Pennsylvanian sea. A luxuriant growth of forest plants, many quite different from the plants of today, flourished in the warm Pennsylvanian climate. Today's common deciduous trees were not present, and the flowering plants had not yet evolved. Instead, the jungle-like forests were dominated by giant ancestors of present-day club mosses, horsetails, ferns, conifers, and cycads. The undergrowth also was well developed, consisting of many ferns, fernlike plants, and small club mosses. Most of the plant fossils found in the coals and associated sedimentary rocks show no annual growth rings, suggesting rapid growth rates and lack of seasonal variations in the climate. Many of the Pennsylvanian plants, such as the seed ferns, eventually became extinct.

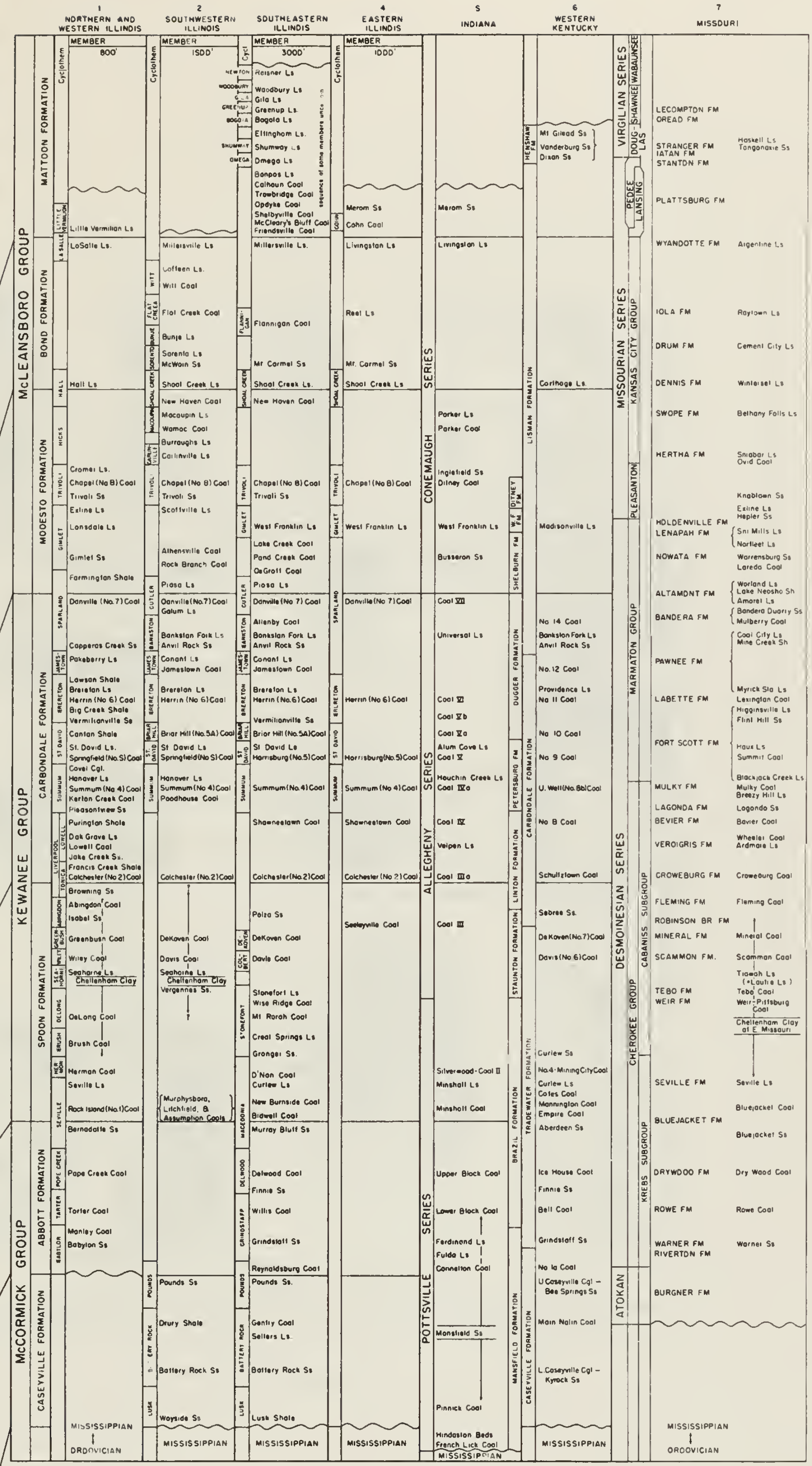
Plant debris from the rapidly growing swamp forests—leaves, twigs, branches, and logs—accumulated as thick mats of peat on the floors of the swamps. Normally, vegetable matter rapidly decays by oxidation, forming water, nitrogen, and carbon dioxide. However, the cover of swamp water, which was probably stagnant and low in oxygen, prevented the complete oxidation and decay of the peat deposits.

The periodic invasions of the Pennsylvanian sea across the coastal swamps killed the Pennsylvanian forests and initiated marine conditions of deposition. The peat deposits were buried by marine sediments. Following burial, the peat deposits were gradually transformed into coal by slow chemical and physical changes in which pressure (compaction by the enormous weight of overlying sedimentary layers), heat (also due to deep burial), and time were the most important factors. Water and volatile substances (nitrogen, hydrogen, and oxygen) were slowly driven off during the coalification process, and the peat deposits were changed into coal.

Coals have been classified by ranks that are based on the degree of coalification. The commonly recognized coals, in order of increasing rank, are (1) brown coal or lignite, (2) sub-bituminous, (3) bituminous, (4) semibituminous, (5) semianthracite, and (6) anthracite. Each increase in rank is characterized by larger amounts of fixed carbon and smaller amounts of oxygen and other volatiles. Hardness of coal also increases with increasing rank. All Illinois coals are classified as bituminous.

Underclays occur beneath most of the coals in Illinois. Because underclays are generally unstratified (unlayered), are leached to a bleached appearance, and generally contain plant roots, many geologists consider that they represent the ancient soils on which the coal-forming plants grew.

The exact origin of the carbonaceous black shales that occur above many coals is uncertain. The black shales probably are deposits formed under restricted marine (lagoonal) conditions during the initial part of the invasion cycle, when the region was partially closed off from the open sea. In any case, they were deposited in quiet-water areas where very fine, iron-rich muds and finely divided plant debris were washed in from the land. The high organic content of the black shales is also in part due to the carbonaceous remains of plants and animals that lived in the lagoons. Most of the fossils represent planktonic (floating) and nektonic (swimming) forms—not benthonic (bottom dwelling) forms. The depauperate (dwarf) fossil forms sometimes found in black shales formerly were thought to have been forms that were stunted by toxic conditions in the sulfide-rich, oxygen-deficient waters of the lagoons. However, study has shown that the "depauperate" fauna consists mostly of normal-size individuals of species that never grew any larger.



ROCK STRATIGRAPHIC

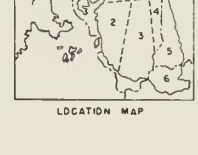
AND

CYCLICAL CLASSIFICATIONS

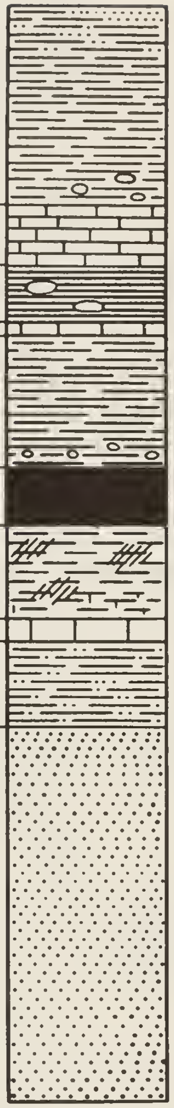
OF THE

PENNSYLVANIAN STRATA OF ILLINOIS

1960



LOCATION MAP



10 Shale, gray, sandy at top; contains marine fossils and ironstone concretions especially in lower part.

9 Limestone; contains marine fossils.

8 Shale, black, hard, laminated; contains large spheroidal concretions ("Niggerheads") and marine fossils.

7 Limestone; contains marine fossils.

6 Shale, gray; pyritic nodules and ironstone concretions common at base; plant fossils locally common at base; marine fossils rare.

5 Coal; locally contains clay or shale partings.

4 Underclay, mostly medium to light gray except dark gray at top; upper part noncalcareous, lower part calcareous.

3 Limestone, argillaceous; occurs in nodules or discontinuous beds; usually nonfossiliferous.

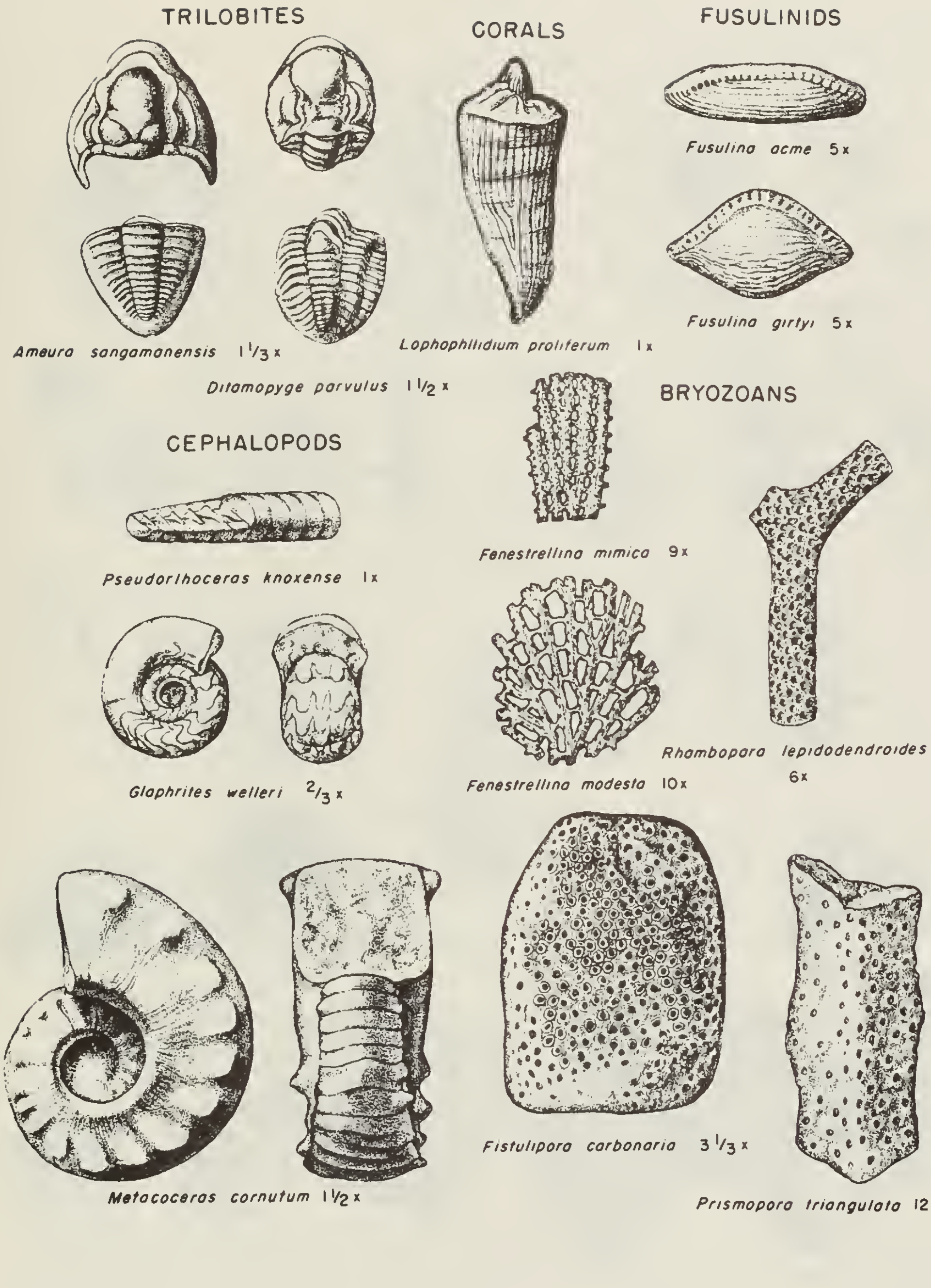
2 Shale, gray, sandy.

1 Sandstone, fine-grained, micaceous, and siltstone, argillaceous; variable from massive to thin-bedded; usually with an uneven lower surface.

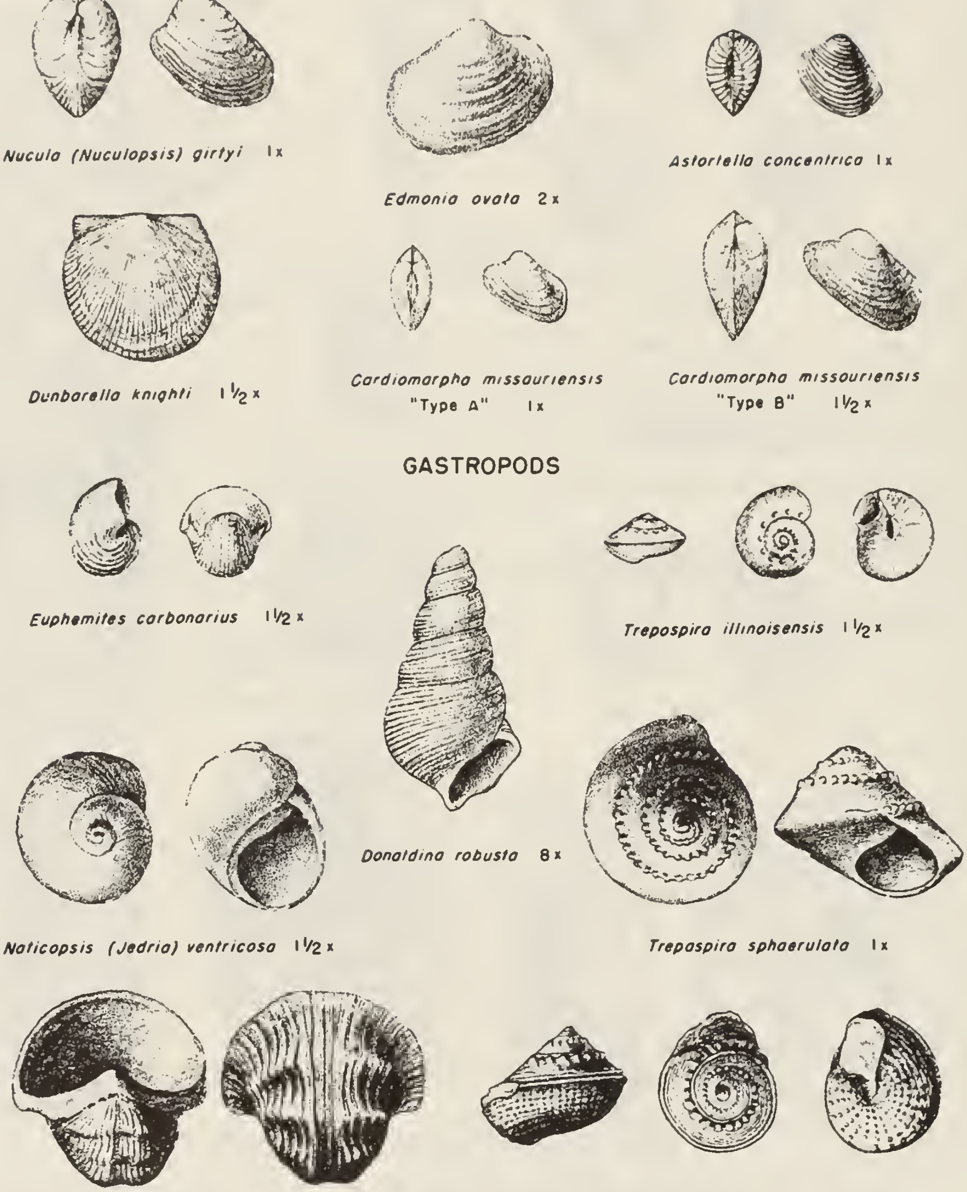
AN IDEALLY COMPLETE CYCLOTHEM

(Reprinted from Fig. 42, Bulletin No. 66, Geology and Mineral Resources of the Marseilles, Ottawa, and Streator Quadrangles, by H. B. Willman and J. Norman Payne)

(47669—15M—11-61)

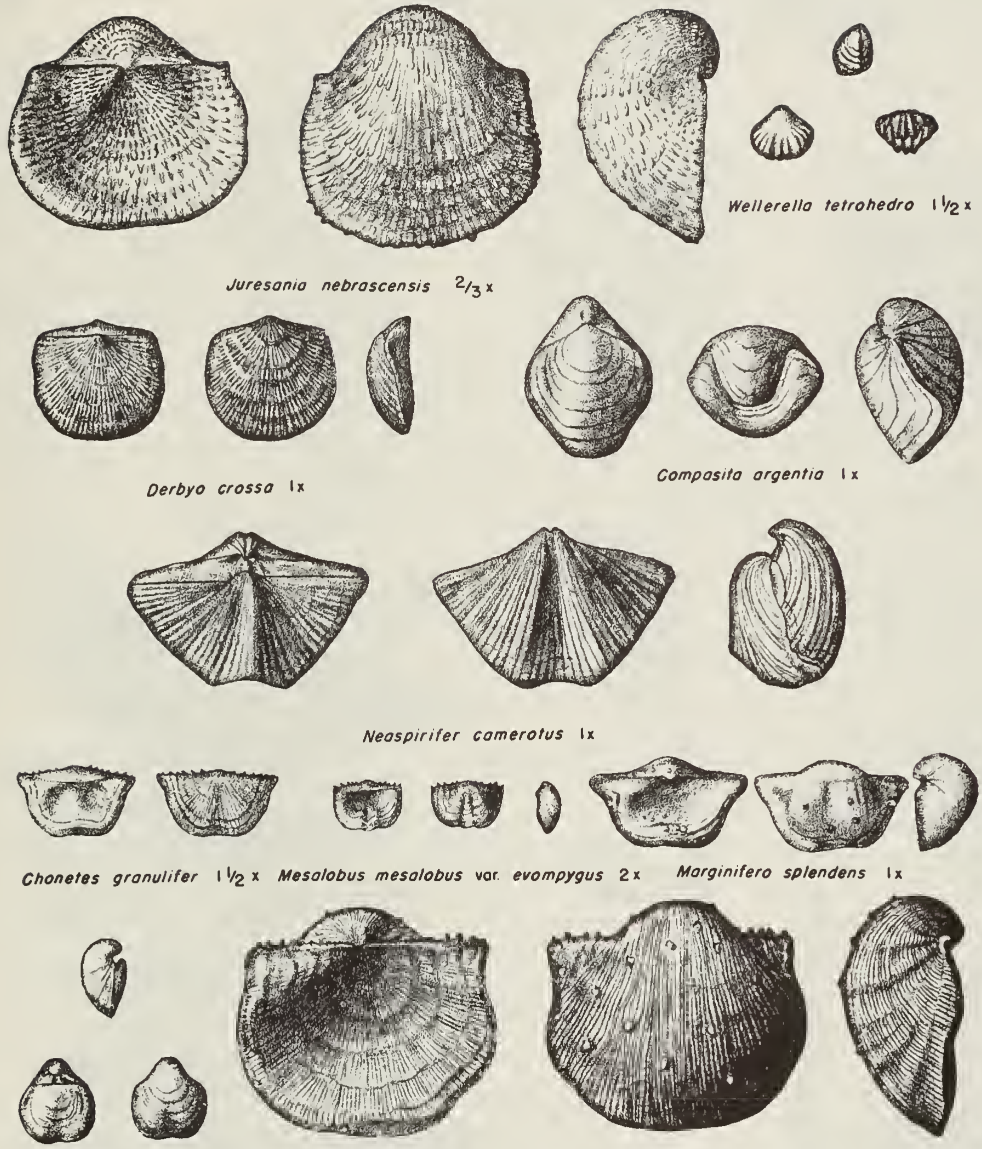

TRILOBITES
CORALS
FUSULINIDS
Fusulina acme 5 x
Fusulina girtyi 5 x
Ameura sangamonensis 1 1/3 x
Lophophllidium proliferum 1 x
Ditamopyge parvulus 1 1/2 x
BRYOZOANS
CEPHALOPODS
Pseudorthoceras knoxense 1 x
Fenestrellina mimica 9 x
Glaphrites welleri 2/3 x
Fenestrellina modesta 10 x
Rhombopora lepidodendroides 6 x
Metacoceras cornutum 1 1/2 x
Fistulipora carbonaria 3 1/3 x
Prismopora triangulata 12 x

PELECYPODS



Nucula (Nuculopsis) girtyi 1x
Edmonia ovata 2x
Astortella concentrica 1x
Dunbarella knighti 1 1/2 x
Cardiomarpha missauriensis "Type A" 1x
Cardiomorpha missouriensis "Type B" 1 1/2 x
GASTROPODS
Euphemites carbonarius 1 1/2 x
Trepospira illinoisensis 1 1/2 x
Donaldina robusta 8x
Naticopsis (Jedria) ventricosa 1 1/2 x
Trepaspira sphaerulata 1x
Knightites montfortianus 2x
Glabrocingulum (Glabrocingulum) grayvillense 3x

BRACHIOPODS



FOSSIL PLANTS, FRANCIS CREEK SHALE

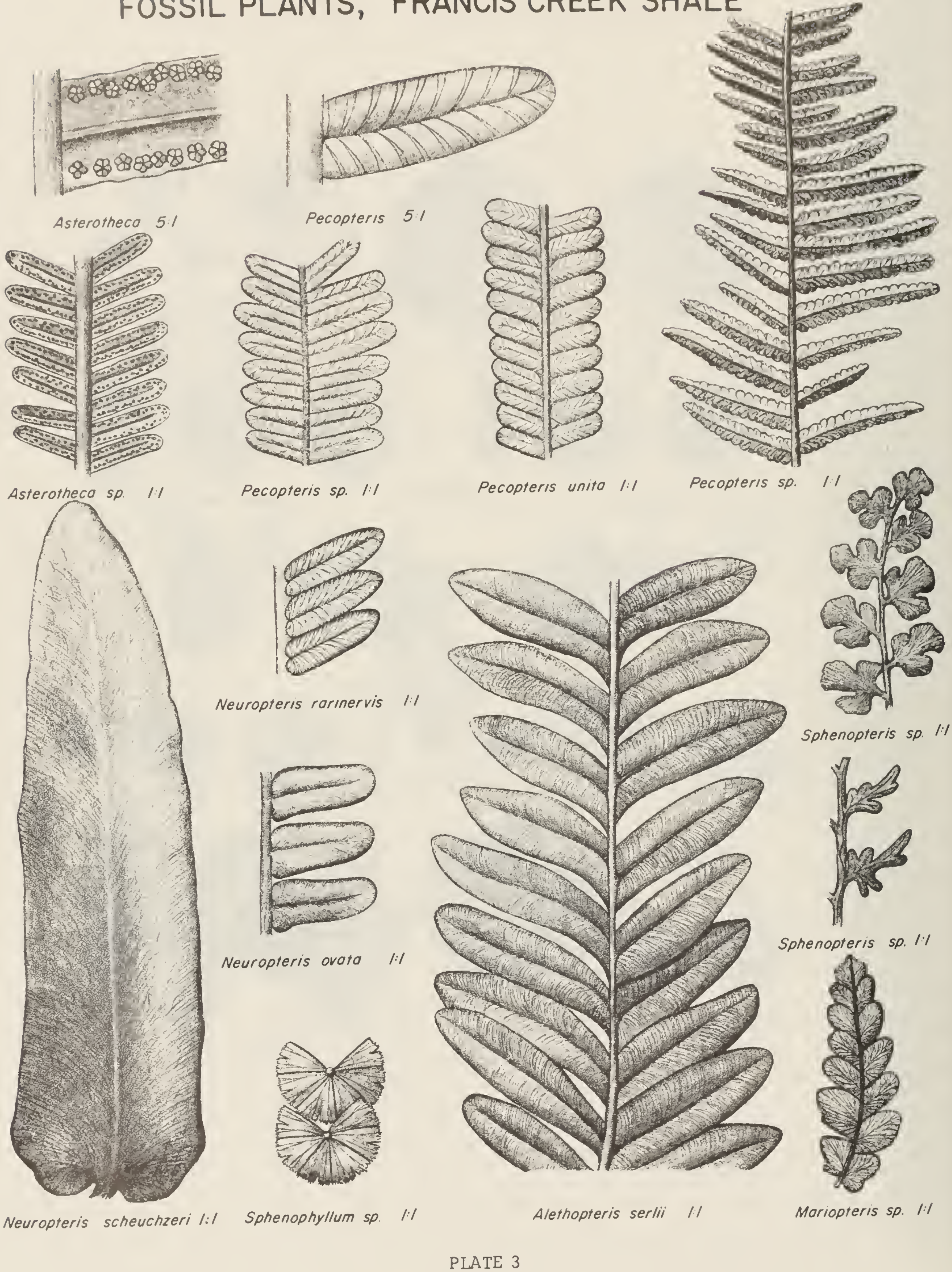
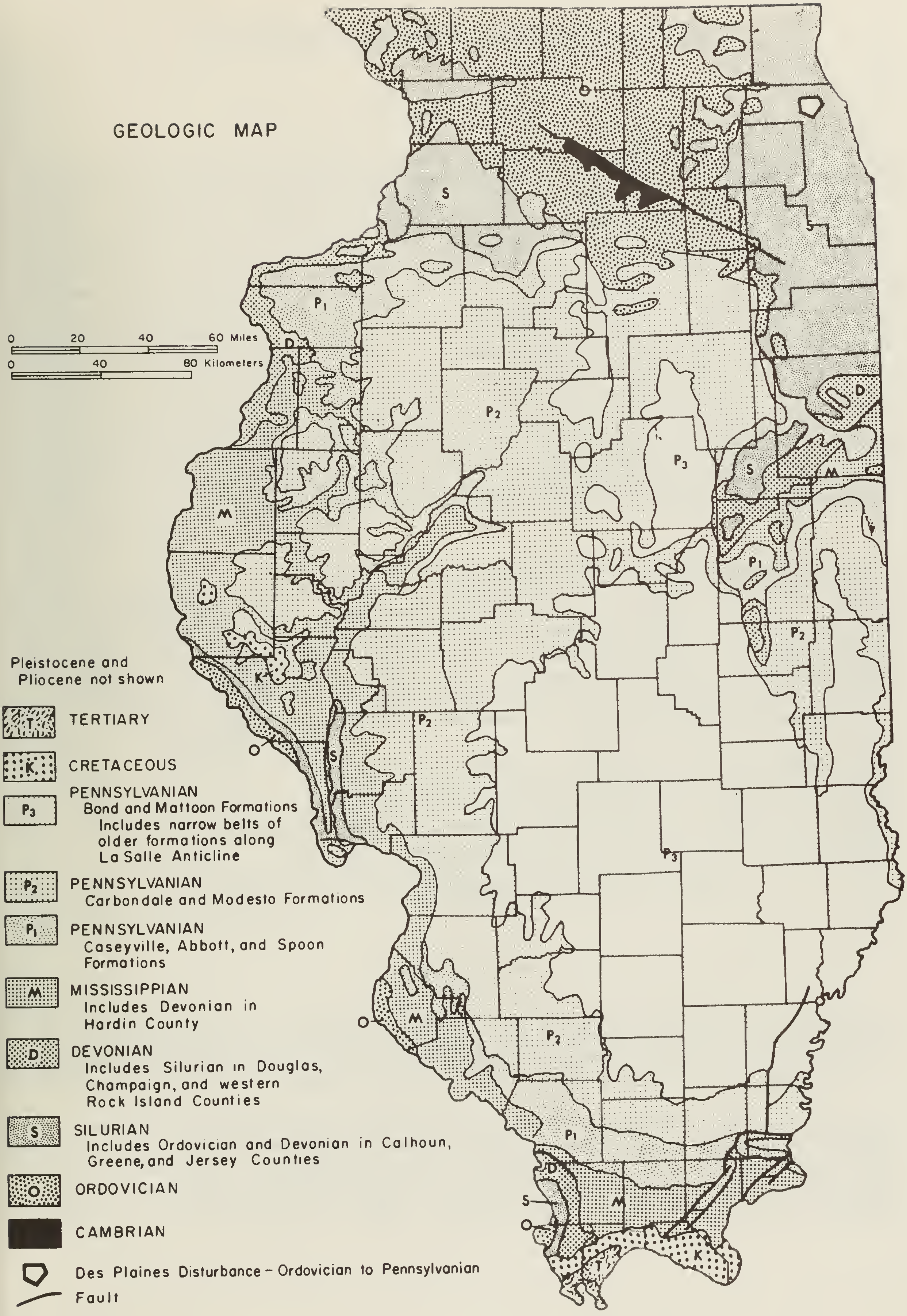


PLATE 3
(corrected)



GEOLOGIC MAP
0 20 40 60 Miles
0 40 80 Kilometers
Pleistocene and Pliocene not shown
TERTIARY
CRETACEOUS
PENNSYLVANIAN
Bond and Mattoon Formations
Includes narrow belts of older formations along La Salle Anticline
PENNSYLVANIAN
Carbondale and Modesto Formations
PENNSYLVANIAN
Caseyville, Abbott, and Spoon Formations
MISSISSIPPIAN
Includes Devonian in Hardin County
DEVONIAN
Includes Silurian in Douglas, Champaign, and western Rock Island Counties
SILURIAN
Includes Ordovician and Devonian in Calhoun, Greene, and Jersey Counties
ORDOVICIAN
CAMBRIAN
Des Plaines Disturbance – Ordovician to Pennsylvanian
Fault

PLEISTOCENE GLACIATIONS IN ILLINOIS

Origin of the Glaciers

During the past million years or so, an interval of time called the Pleistocene Epoch, most of the northern hemisphere above the 50th parallel has been repeatedly covered by glacial ice. The cooling of the earth's surface, a prerequisite for glaciation, began at least 2 million years ago. On the basis of evidence found in subpolar oceans of the world (temperature-dependent fossils and oxygen-isotope ratios), a recent proposal has been made to recognize the beginning of the Pleistocene at 1.6 million years ago. Ice sheets formed in sub-arctic regions many times and spread outward until they covered the northern parts of Europe and North America. In North America, early studies of the glacial deposits led to the model that four glaciations could explain the observed distribution of glacial deposits. The deposits of a glaciation were separated from each other by the evidence of intervals of time during which soils formed on the land surface. In order of occurrence from the oldest to the youngest, they were given the names Nebraskan, Kansan, Illinoian, and Wisconsinan Stages of the Pleistocene Epoch. Work in the last 30 years has shown that there were more than four glaciations but the actual number and correlations at this time are not known. Estimates that are gaining credibility suggest that there may have been about 14 glaciations in the last one million years. In Illinois, estimates range from 4 to 8 based on buried soils and glacial deposits. For practical purposes, the previous four glacial stage model is functional, but we now know that the older stages are complex and probably contain more than one glaciation. Until we know more, all of the older glacial deposits, including the Nebraskan and Kansan will be classified as pre-Illinoian. The limits and times of the ice movement in Illinois are illustrated in the following pages by several figures.

The North American ice sheets developed when the mean annual temperature was perhaps 4° to 7°C (7° to 13°F) cooler than it is now and winter snows did not completely melt during the summers. Because the time of cooler conditions lasted tens of thousands of years, thick masses of snow and ice accumulated to form glaciers. As the ice thickened, the great weight of the ice and snow caused them to flow outward at their margins, often for hundreds of miles. As the ice sheets expanded, the areas in which snow accumulated probably also increased in extent.

Tongues of ice, called lobes, flowed southward from the Canadian centers near Hudson Bay and converged in the central lowland between the Appalachian and Rocky Mountains. There the glaciers made their farthest advances to the south. The sketch below shows several centers of flow, the general directions of flow from the centers, and the southern extent of glaciation. Because Illinois lies entirely in the central lowland, it has been invaded by glaciers from every center.

Effects of Glaciation

Pleistocene glaciers and the waters melting from them changed the landscapes they covered. The glaciers scraped and smeared the landforms they overrode, leveling and filling many of the minor valleys and even some of the larger ones. Moving ice carried colossal amounts of rock and earth, for much of what the glaciers wore off the ground was kneaded into the moving ice and carried along, often for hundreds of miles.

The continual floods released by melting ice entrenched new drainageways, deepened old ones, and then partly refilled both with sediments as great quantities of rock and earth were carried beyond the glacier fronts. According to some estimates, the amount of water drawn from the sea and changed into ice during a glaciation was enough to lower the sea level from 300 to 400 feet below present level. Consequently, the melting of a continental ice sheet provided a tremendous volume of water that eroded and transported sediments.

In most of Illinois, then, glacial and meltwater deposits buried the old rock-ribbed, low, hill-and-valley terrain and created the flatter landforms of our prairies. The mantle of soil material and the buried deposits of gravel, sand, and clay left by the glaciers over about 90 percent of the state have been of incalculable value to Illinois residents.

Glacial Deposits

The deposits of earth and rock materials moved by a glacier and deposited in the area once covered by the glacier are collectively called **drift**. Drift that is ice-laid is called **till**. Water-laid drift is called **outwash**.

Till is deposited when a glacier melts and the rock material it carries is dropped. Because this sediment is not moved much by water, a till is unsorted, containing particles of different sizes and compositions. It is also stratified (unlayered). A till may contain materials ranging in size from microscopic clay particles to large boulders. Most tills in Illinois are pebbly clays with only a few boulders. For descriptive purposes, a mixture of clay, silt, sand and boulders is called **diamicton**. This is a term used to describe a deposit that could be interpreted as till or a mass wasting product.

Tills may be deposited as **end moraines**, the arc-shaped ridges that pile up along the glacier edges where the flowing ice is melting as fast as it moves forward. Till also may be deposited as **ground moraines**, or **till plains**, which are gently undulating sheets deposited when the ice front melts back, or retreats. Deposits of till identify areas once covered by glaciers. Northeastern Illinois has many alternating ridges and plains, which are the succession of end moraines and till plains deposited by the Wisconsinan glacier.

Sorted and stratified sediment deposited by water melting from the glacier is called **outwash**. Outwash is bedded, or layered, because the flow of water that deposited it varied in gradient, volume, velocity, and direction. As a meltwater stream washes the rock materials along, it sorts them by size—the fine sands, silts, and clays are carried farther downstream than the coarser gravels and cobbles. Typical Pleistocene outwash in Illinois is in multilayered beds of clays, silts, sands, and gravels that look much like modern stream deposits in some places. In general, outwash tends to be coarser and less weathered, and alluvium is most often finer than medium sand and contains variable amounts of weathered material.

Outwash deposits are found not only in the area covered by the ice field but sometimes far beyond it. Meltwater streams ran off the top of the glacier, in crevices in the ice, and under the ice. In some places, the cobble-gravel-sand filling of the bed of a stream that flowed in the ice is preserved as a sinuous ridge called an **esker**. Some eskers in Illinois are made up of sandy to silty deposits and contain mass wasted diamicton material. Cone-shaped mounds of coarse outwash, called **kames**, were formed where meltwater plunged through crevasses in the ice or into ponds on the glacier.

The finest outwash sediments, the clays and silts, formed bedded deposits in the ponds and lakes that filled glacier-dammed stream valleys, the sags of the till plains, and some low, moraine-diked till plains. Meltwater streams that entered a lake rapidly lost speed and also quickly dropped the sands and gravels they carried, forming deltas at the edge of the lake. Very fine sand and silts were commonly redistributed on the lake bottom by wind-generated currents, and the clays, which stayed in suspension longest, slowly settled out and accumulated with them.

Along the ice front, meltwater ran off in innumerable shifting and short-lived streams that laid down a broad, flat blanket of outwash that formed an **outwash plain**. Outwash was also carried away from the glacier in valleys cut by floods of meltwater. The Mississiippi, Illinois, and Ohio Rivers occupy valleys that were major channels for meltwaters and were greatly widened and deepened during times of the greatest meltwater floods. When the floods waned, these valleys were partly filled with outwash far beyond the ice margins. Such outwash deposits, largely sand and gravel, are known as **valley trains**. Valley train deposits may be both extensive and thick. For instance, the long valley train of the Mississippi Valley is locally as much as 200 feet thick.

Loess, Eolian Sand and Soils

One of the most widespread sediments resulting from glaciation was carried not by ice or water but by wind. **Loess** is the name given to windblown deposits dominated by silt. Most of the silt was derived from wind erosion of the valley trains. Wind action also sorted out **eolian sand** which commonly formed **sand dunes** on the valley trains or on the adjacent uplands. In places, sand dunes have migrated up to 10 miles away from the principle source of sand. Flat areas between dunes are generally underlain by eolian **sheet sand** that is commonly reworked by water action. On uplands along the major valley trains, loess and eolian sand are commonly interbedded. With increasing distance from the valleys, the eolian sand pinches out, often within one mile.

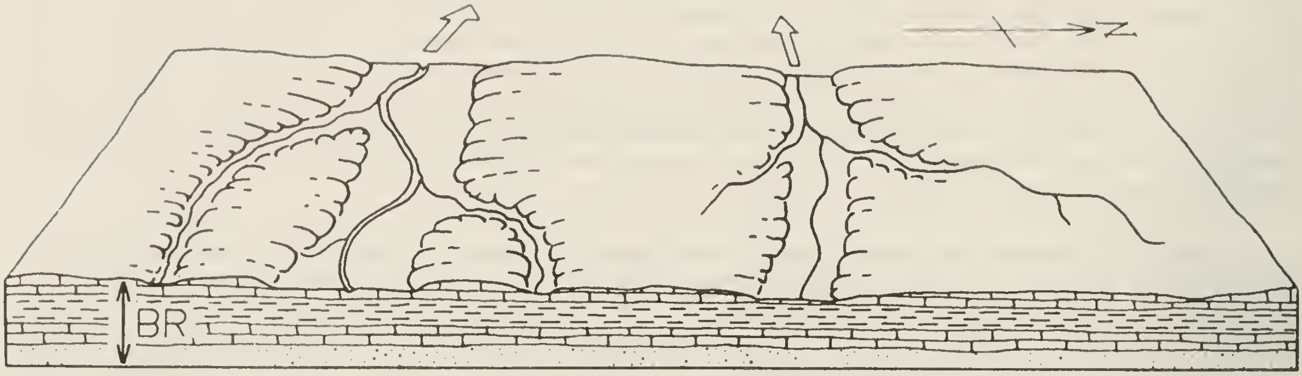
Eolian deposition occurred when certain climatic conditions were met, probably in a seasonal pattern. Deposition could have occurred in the fall, winter or spring season when low precipitation rates and low temperatures caused meltwater floods to abate, exposing the surfaces of the valley trains and permitting them to dry out. During Pleistocene time, as now, west winds prevailed, and the loess deposits are thickest on the east sides of the source valleys. The loess thins rapidly away from the valleys but extends over almost all the state.

Each Pleistocene glaciation was followed by an interglacial stage that began when the climate warmed enough to melt the glaciers and their snowfields. During these warmer intervals, when the climate was similar to that of today, drift and loess surfaces were exposed to weather and the activities of living things. Consequently, over most of the glaciated terrain, soils developed on the Pleistocene deposits and altered their composition, color, and texture. Such soils were generally destroyed by later glacial advances, but some were buried. Those that survive serve as "key beds," or stratigraphic markers, and are evidence of the passage of a long interval of time.

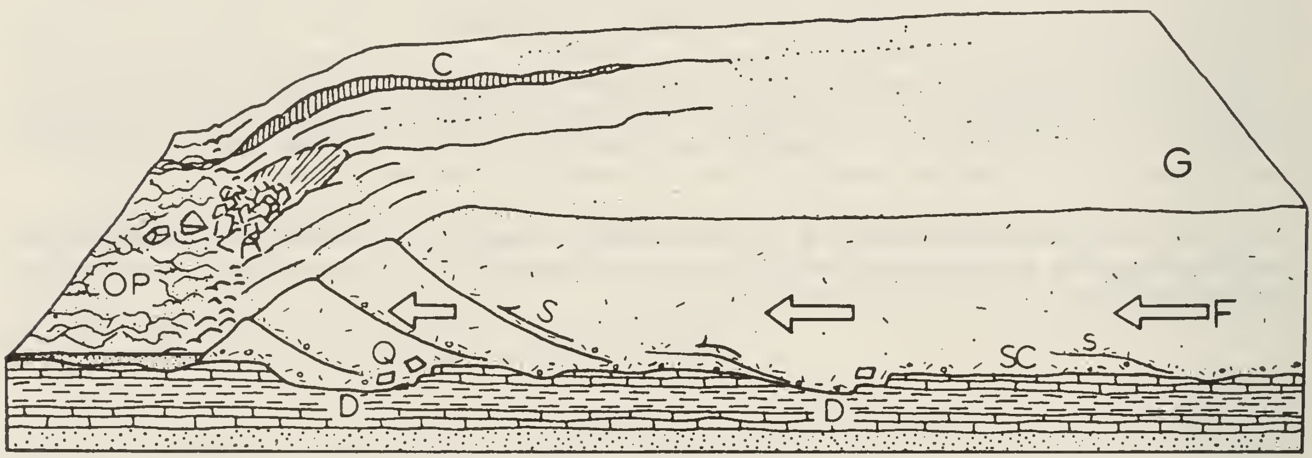
Glaciation in a Small Illinois Region

The following diagrams show how a continental ice sheet might have looked at various stages as it moved across a small region in Illinois. They illustrate how it could change the old terrain and create a landscape like the one we live on. To visualize how these glaciers looked, geologists study the landforms and materials left in the glaciated regions and also the present-day mountain glaciers and polar ice caps.

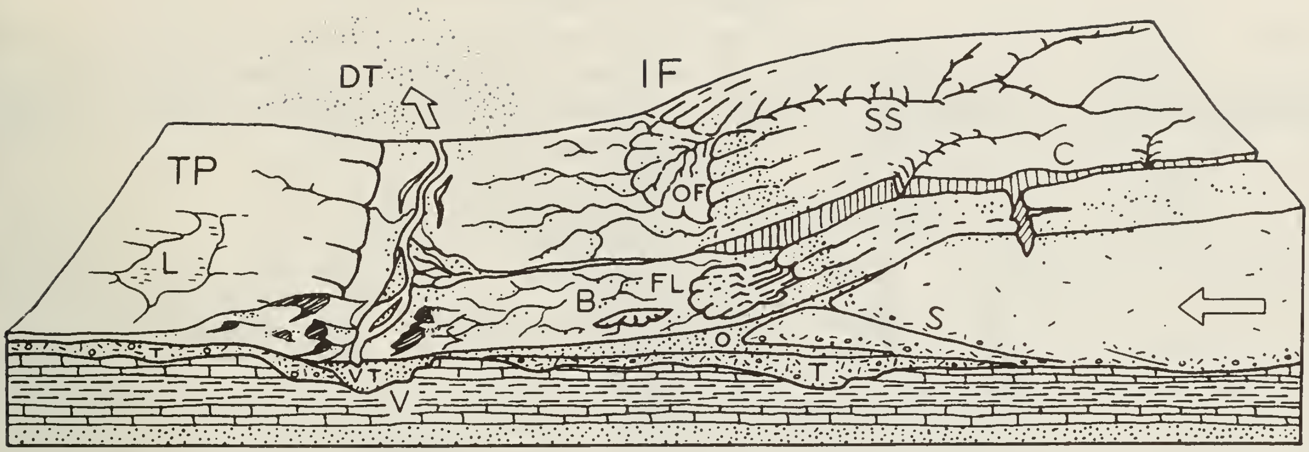
The block of land in the diagrams is several miles wide and about 10 miles long. The vertical scale is exaggerated—layers of material are drawn thicker and landforms higher than they ought to be so that they can be easily seen.



1. **The Region Before Glaciation** — Like most of Illinois, the region illustrated is underlain by almost flat-lying beds of sedimentary rocks—layers of sandstone ( ), limestone ( ), and shale ( ). Millions of years of erosion have planed down the bedrock (BR), creating a terrain of low uplands and shallow valleys. A residual soil weathered from local rock debris covers the area but is too thin to be shown in the drawing. The streams illustrated here flow westward and the one on the right flows into the other at a point beyond the diagram.



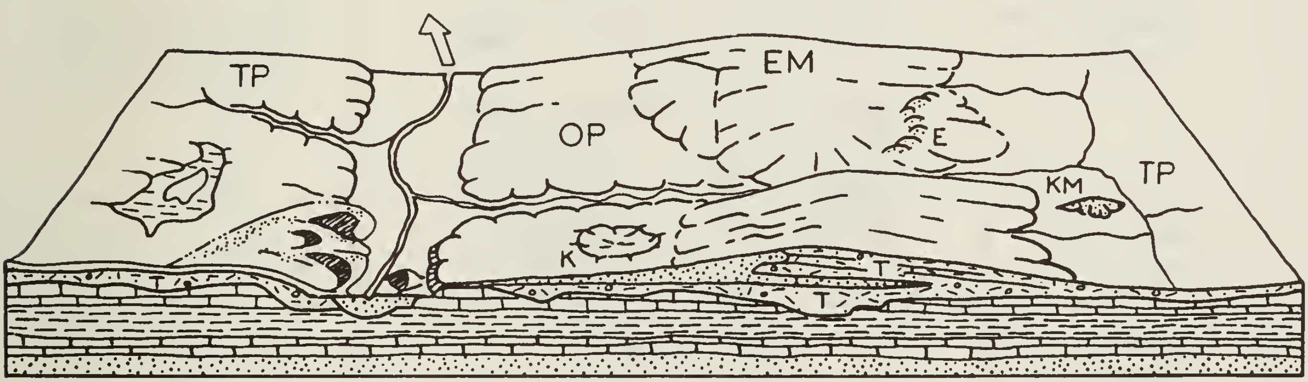
2. **The Glacier Advances Southward** — As the Glacier (G) spreads out from its ice snowfield accumulation center, it scours (SC) the soil and rock surface and quarries (Q)—pushes and plucks up—chunks of bedrock. The materials are mixed into the ice and make up the glacier's "load." Where roughnesses in the terrain slow or stop flow (F), the ice "current" slides up over the blocked ice on innumerable shear planes (S). Shearing mixes the load very thoroughly. As the glacier spreads, long cracks called "crevasses" (C) open parallel to the direction of ice flow. The glacier melts as it flows forward, and its meltwater erodes the terrain in front of the ice, deepening (D) some old valleys before ice covers them. Meltwater washes away some of the load freed by melting and deposits it on the outwash plain (OP). The advancing glacier overrides its outwash and in places scours much of it up again. The glacier may be 5000 or so feet thick, and tapers to the margin, which was probably in the range of several hundred feet above the old terrain. The ice front advances perhaps as much as a third of a mile per year.



3. **The Glacier Deposits an End Moraine** — After the glacier advances across the area, the climate warms and the ice begins to melt as fast as it advances. The ice front (IF) is now stationary, or fluctuating in a narrow area, and the glacier is depositing an end moraine.

As the top of the glacier melts, some of the sediment that is mixed in the ice accumulates on top of the glacier. Some is carried by meltwater onto the sloping ice front (IF) and out onto the plain beyond. Some of the debris slips down the ice front in a mudflow (FL). Meltwater runs through the ice in a crevasse (C). A supraglacial stream (SS) drains the top of the ice, forming an outwash fan (OF). Moving ice has overridden an immobile part of the front on a shear plane (S). All but the top of a block of ice (B) is buried by outwash (O).

Sediment from the melted ice of the previous advance (figure 2) remains as a till layer (T), part of which forms the till plain (TP). A shallow, marshy lake (L) fills a low place in the plain. Although largely filled with drift, the valley (V) remains a low spot in the terrain. As soon as the ice cover melts, meltwater drains down the valley, cutting it deeper. Later, outwash partly refills the valley: the outwash deposit is called a valley train (VT). Wind blows dust (DT) off the dry floodplain. The dust will form a loess deposit when it settles. Sand dunes (D) form on the south and east sides of streams.



4. **The Region after Glaciation** — As the climate warms further, the whole ice sheet melts, and glaciation ends. The end moraine (EM) is a low, broad ridge between the outwash plain (OP) and till plains (TP). Run-off from rains cuts stream valleys into its slopes. A stream goes through the end moraine along the channel cut by the meltwater that ran out of the crevasse in the glacier.

Slopewash and vegetation are filling the shallow lake. The collapse of outwash into the cavity left by the ice block's melting has made a kettle (K). The outwash that filled a tunnel draining under the glacier is preserved in an esker (E). The hill of outwash left where meltwater dumped sand and gravel into a crevasse or other depression in the glacier or at its edge is a kame (KM). A few feet of loess covers the entire area but cannot be shown at this scale.

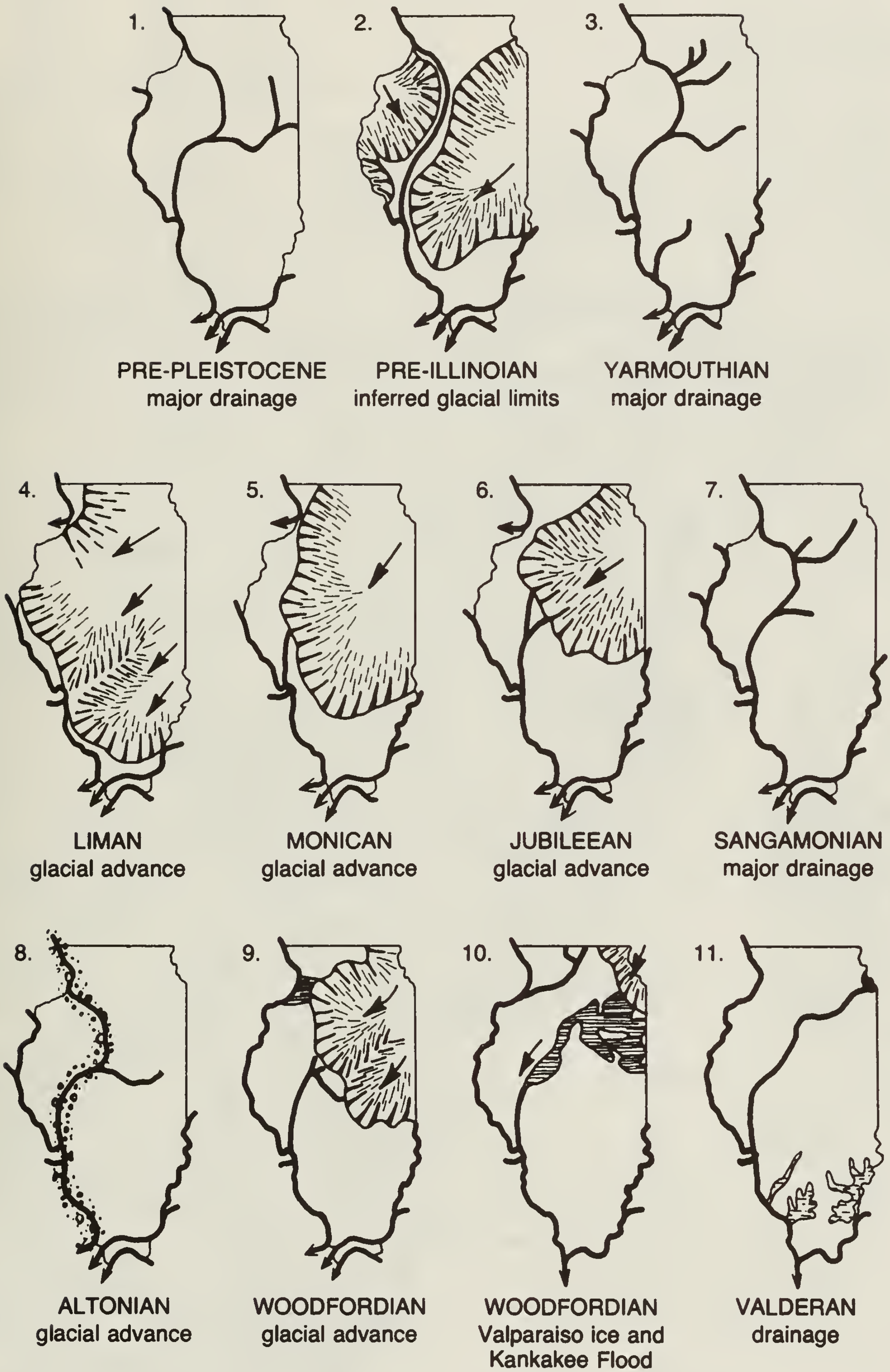
TIME TABLE OF PLEISTOCENE GLACIATION

			STAGE		SUBSTAGE	NATURE OF DEPOSITS	SPECIAL FEATURES
QUATERNARY			HOLOCENE (interglacial)		Years Before Present	Soil, youthful profile of weathering, lake and river deposits, dunes, peat	
					10,000		
	Pleistocene		WISCONSINAN (glacial)	late	Valderan	Outwash, lake deposits	Outwash along Mississippi Valley
					11,000		
					Twocreekan	Peat and alluvium	Ice withdrawal, erosion
					12,500		
					Woodfordian	Drift, loess, dunes, lake deposits	Glaciation; building of many moraines as far south as Shelbyville; extensive valley trains, outwash plains, and lakes
					25,000		
				mid	Farmdalian	Soil, silt, and peat	Ice withdrawal, weathering, and erosion
					28,000		
				early	Altonian	Drift, loess	Glaciation in Great Lakes area, valley trains along major rivers
					75,000		
			SANGAMONIAN (interglacial)			Soil, mature profile of weathering	Important stratigraphic marker
					125,000		
			ILLINOIAN (glacial)		Jubileean	Drift, loess, outwash	Glaciers from northeast at maximum reached Mississippi River and nearly to southern tip of Illinois
					Monican	Drift, loess, outwash	
					Liman	Drift, loess, outwash	
					300,000?		
			YARMOUTHIAN (interglacial)			Soil, mature profile of weathering	Important stratigraphic marker
					500,000?		
		Pre-Illinoian	KANSAN* (glacial)			Drift, loess	Glaciers from northeast and northwest covered much of state
					700,000?		
			AFTONIAN* (interglacial)			Soil, mature profile of weathering	(hypothetical)
					900,000?		
			NEBRASKAN* (glacial)			Drift (little known)	Glaciers from northwest invaded western Illinois
					1,600,000 or more		

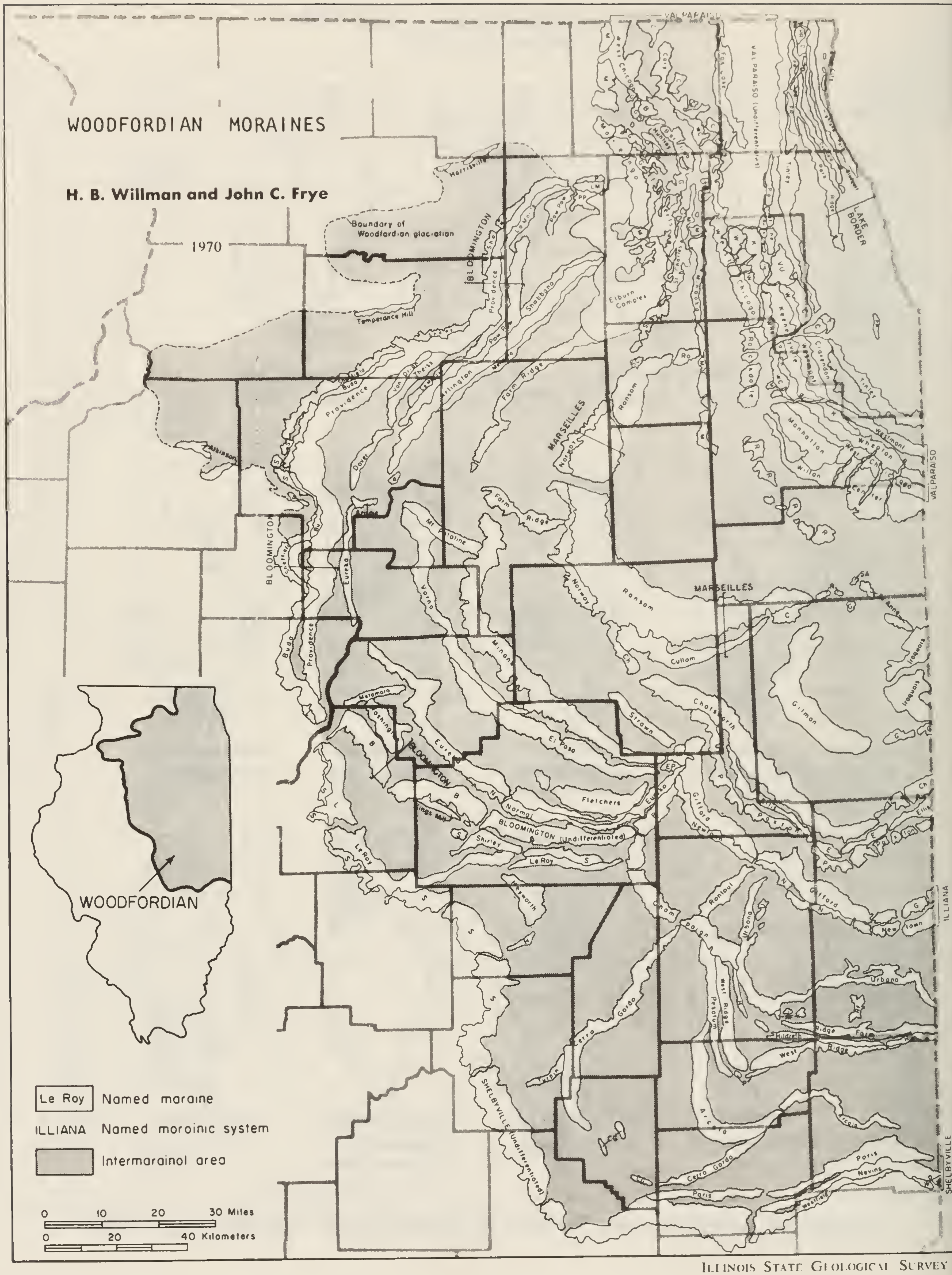
*Old oversimplified concepts, now known to represent a series of glacial cycles.

(Illinois State Geological Survey, 1973)

SEQUENCE OF GLACIATIONS AND INTERGLACIAL DRAINAGE IN ILLINOIS



(Modified from Willman and Frye, "Pleistocene Stratigraphy of Illinois," ISGS Bull. 94, fig. 5, 1970.)


WOODFORDIAN MORAINES
H. B. Willman and John C. Frye
1970
Boundary of Woodfordian glaciation
VALPARAISO
LAKE BORDER
BLOOMINGTON
MARSEILLES
ILLIANA
SHELBYVILLE
BLOOMINGTON (Undifferentiated)
SHELBYVILLE (Undifferentiated)
VALPARAISO (Undifferentiated)
Elburn Complex
Temperance Hill
Harrisville
Providence
Shabbona
Farm Ridge
Arlington
Van Orin
Dover
Buda
Sheffield
Atkinson
Mt Palatine
Eureka
Varna
Minonk
Norway
Ransom
Cullom
Chatsworth
Strawn
El Paso
Fletchers
Normal
Shirley
Le Roy
Metamora
Kings Mill
Heyworth
Gilman
Iroquois
Gifford
Newtown
Rantoul
Champaign
Urbana
West Ridge
Pesotum
Hildreth
Ridge Farm
Cerro Gordo
Arcola
Paris
Nevins
Westfield
Tuscola
Manhattan
Wilton
Wheaton
Westmont
Clarendon
Kings
WOODFORDIAN
Le Roy Named moraine
ILLIANA Named morainic system
Intermorainal area
0 10 20 30 Miles
0 20 40 Kilometers

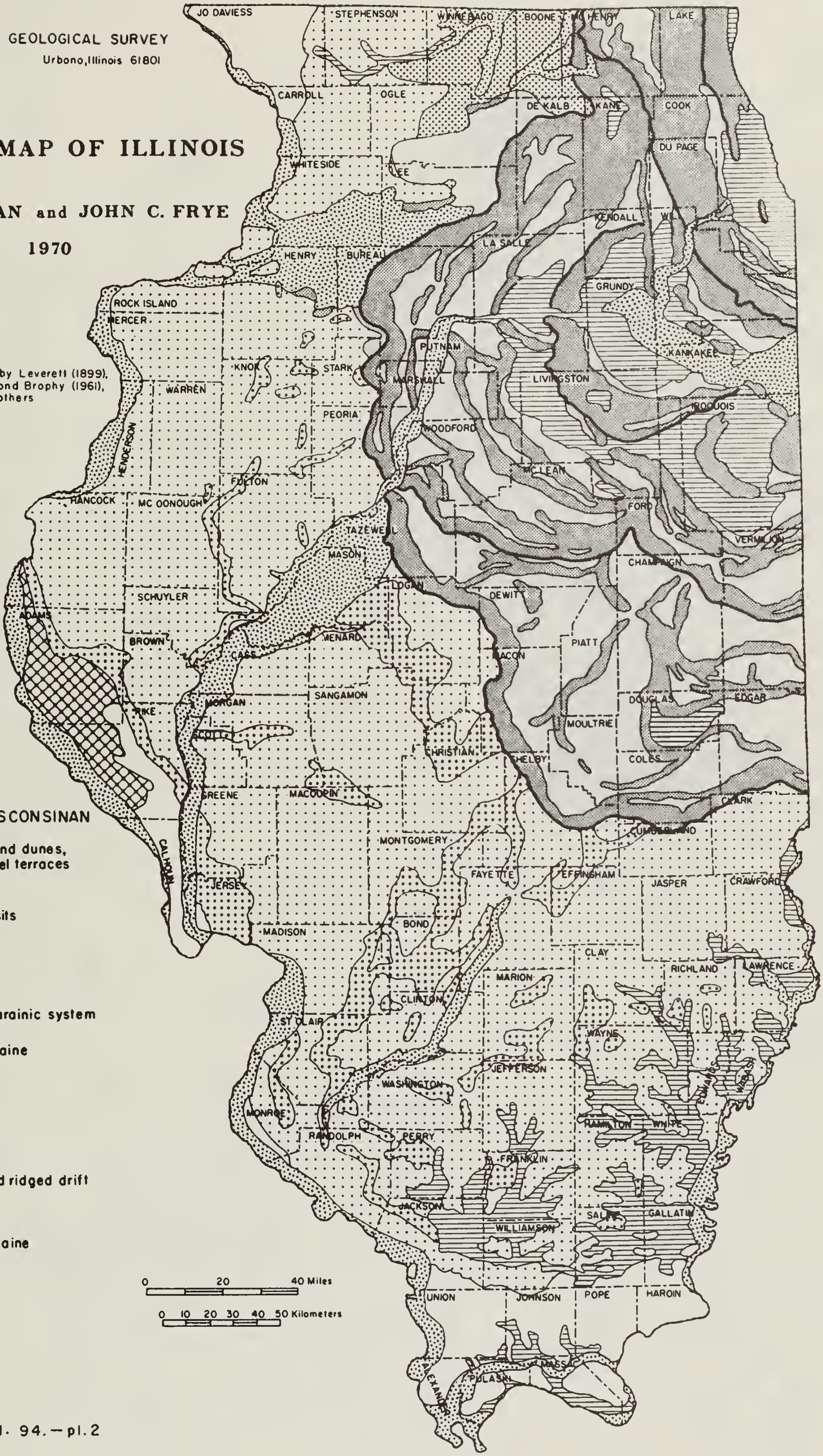
ILLINOIS STATE GEOLOGICAL SURVEY
John C. Frye, Chief   Urbana, Illinois 61801

GLACIAL MAP OF ILLINOIS

H.B. WILLMAN and JOHN C. FRYE

1970

Modified from maps by Leverett (1899), Ekblaw (1959), Leighton and Brophy (1961), Willman et al. (1967), and others



EXPLANATION

HOLOCENE AND WISCONSINAN

Alluvium, sand dunes, and gravel terraces

WISCONSINAN

Lake deposits

WOODFORDIAN

Moraine

Front of morainic system

Groundmoraine

ALTONIAN

Till plain

ILLINOIAN

Moraine and ridged drift

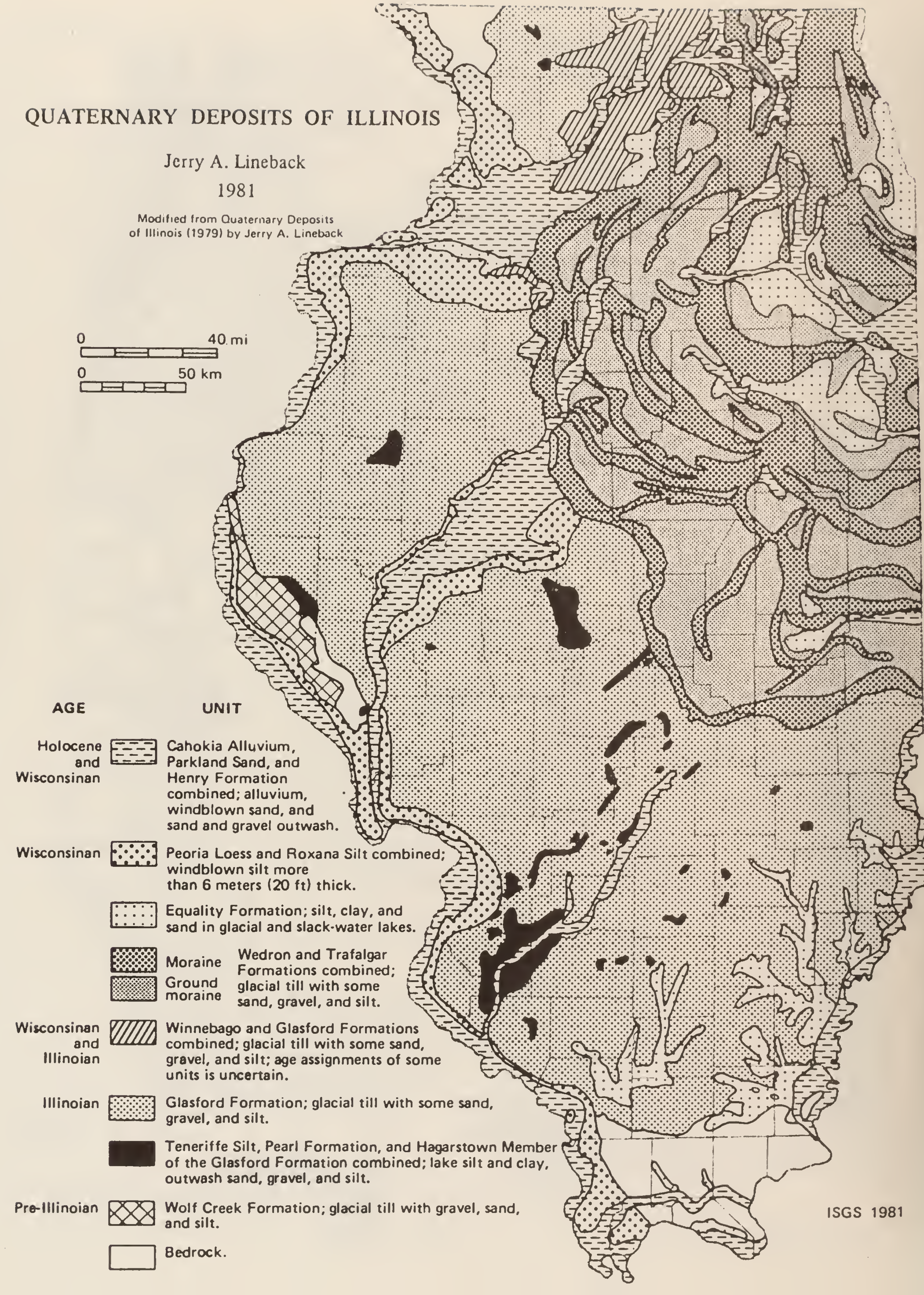
Groundmoraine

KANSAN

Till plain

DRIFTLESS

Modified from Bull. 94.—pl. 2


QUATERNARY DEPOSITS OF ILLINOIS
Jerry A. Lineback
1981
Modified from Quaternary Deposits of Illinois (1979) by Jerry A. Lineback
0
40 mi
0
50 km
AGE
UNIT
Holocene and Wisconsinan
Cahokia Alluvium, Parkland Sand, and Henry Formation combined; alluvium, windblown sand, and sand and gravel outwash.
Wisconsinan
Peoria Loess and Roxana Silt combined; windblown silt more than 6 meters (20 ft) thick.
Equality Formation; silt, clay, and sand in glacial and slack-water lakes.
Moraine
Ground moraine
Wedron and Trafalgar Formations combined; glacial till with some sand, gravel, and silt.
Wisconsinan and Illinoian
Winnebago and Glasford Formations combined; glacial till with some sand, gravel, and silt; age assignments of some units is uncertain.
Illinoian
Glasford Formation; glacial till with some sand, gravel, and silt.
Teneriffe Silt, Pearl Formation, and Hagarstown Member of the Glasford Formation combined; lake silt and clay, outwash sand, gravel, and silt.
Pre-Illinoian
Wolf Creek Formation; glacial till with gravel, sand, and silt.
Bedrock.
ISGS 1981


START
1
2
3
LUNCH 4
5
6
7
END
CANTON
FAIRVIEW
FARMINGTON
JOSHUA
BUCKHEART
PUTMAN
LIVERPOOL
NORRIS
GILCHRIST
BRERETON
INGERSOLL AIRPORT
CUBA
TOLEDO
BRYANT
ST DAVID
DUNFERMLINE
MAPLES MILL
RAWALTS
CANTON LAKE
LAKE WEE-MA-TUK
VAN WINKLE LAKE
BYBEE
PEORIA
SCALE
5 MILES
FEET
KILOMETERS